Engine Mechanical - New Beetle, 1.9L 4-Cyl. (Engine Code BEW)

TECHNICAL DATA

ENGINE NUMBER LOCATIONS

The engine number ("Code letters" and "Serial number") can be found on the joint between the engine and transmission (arrow).

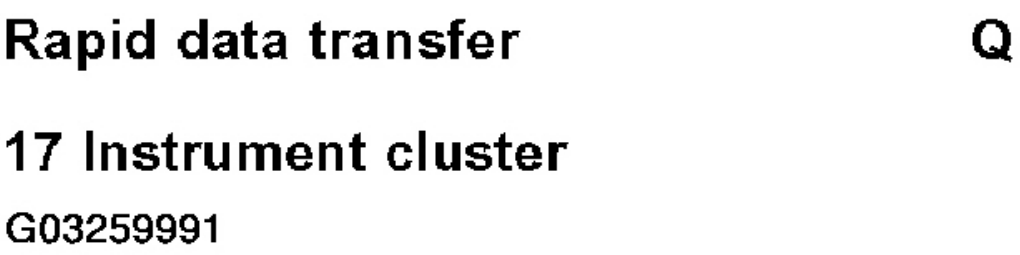

Fig. 1: Locating Engine Number
Courtesy of VOLKSWAGEN OF AMERICA, INC.

The engine number consists of up to nine characters (alphanumeric). The first part (maximal 3 characters) makes up the "engine code", and the second part (6 letters/numbers), the "serial number". If more than 999,999 engines with the same engine code are produced, the first of the six characters is replaced with a letter.

NOTE: There is a sticker on the toothed belt guard with "Engine code" and "Serial number".

The engine code is also included on the vehicle data plate.

ENGINE DATA

ENGINE DATA

Engine code letter		**BEW**
Production		from 07.03
Emissions fulfil		LEV 1
Displacement	liters	1.9
Output	kW at rpm	74/4000
Torque	N.m at rpm	240/1800 to 2400

Bore	diameter mm	79.5
Stroke	mm	95.5
Compression ratio		17.5
CN	min.	49
Ignition sequence		1-3-4-2
Catalytic converter		yes
Exhaust gas recirculation		yes(1)
Turbocharging		yes
Charge air cooling		yes
(1) with exhaust gas heat exchanger		

ENGINE, REMOVING AND INSTALLING

NOTE: The following list refers to items in Fig. 2 .

Special tools and equipment

- 2024 A Engine sling
- T10012 Engine/trans. support
- VW313 Holding fixture
- VW 540 Holding fixture
- V.A.G 1202 A Workshop crane
- V.A.G 1306 Drip tray for VAG1202A

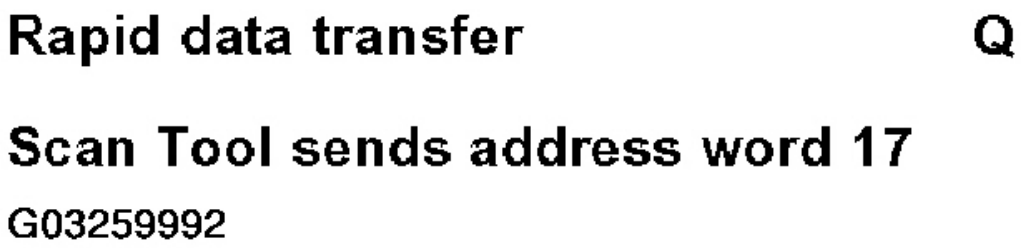

Fig. 2: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 3 .

Special tools and equipment

- V.A.G 1331 Torque wrench (5 to 50 Nm)
- V.A.G 1332 Torque wrench (40 to 200 Nm)
- V.A.G 1383 A Engine/transmission jack
- VAS 5024 Assembly tool for spring-type clips
- VAS 5085 Step ladder
- G 000 100 Lubrication grease (manual transmission only)
- Bolt M10 x 25 / 8.8
- Cable ties

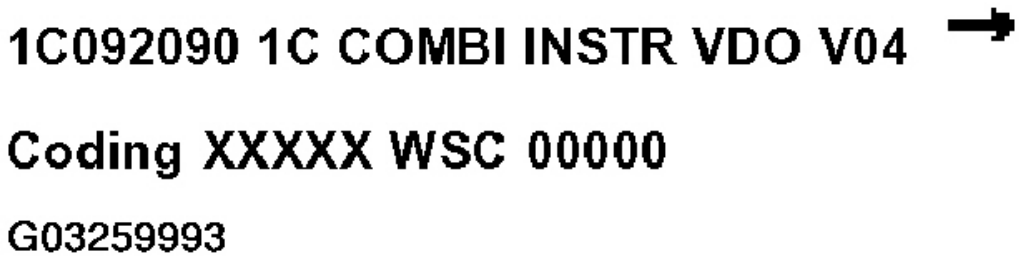

Fig. 3: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTES ON REMOVING

- The engine is removed downward together with the transmission.

CAUTION: When performing repair work, especially due to the confined conditions in the engine compartment, pay attention to the following:

- **Route all types of hoses/lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum) as well as electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

- All cable ties which are opened or cut through when engine is removed must be replaced in the same position when engine is installed.

Work sequence

- Check whether a coded radio is installed. If so, obtain anti-theft coding.
- With ignition switched off disconnect battery Ground (GND) strap.
- Remove engine cover.
    - Pull front of engine cover abruptly upward (arrow -A-) and then pull forward out of rear securing elements (arrow -B-).

Fig. 4: Removing Engine Cover
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove battery.
- Remove air cleaner housing with intake hose.
- Remove battery console.
- Remove lower charge air pipe -1-.
- Remove bolt/screw -2- and release connector (arrow).

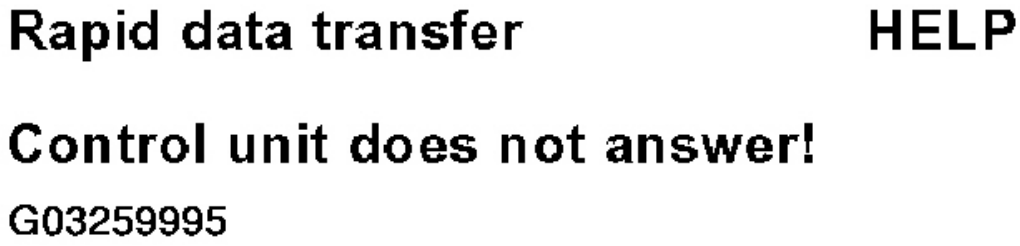

Fig. 5: Removing Lower Charge Air Pipe
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully cover or close open ends.
- Install center and left and right side sound insulation (arrow).

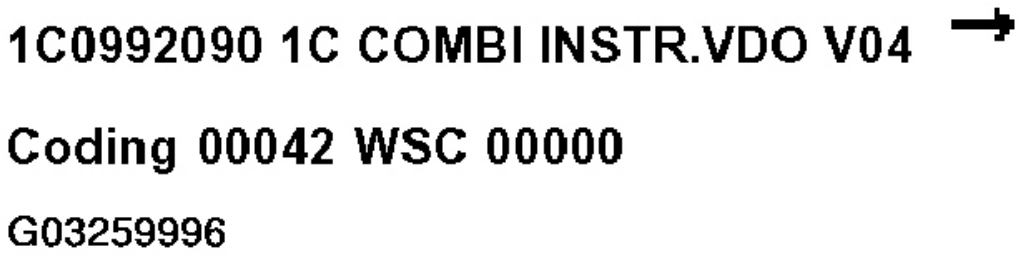

Fig. 6: Identifying Center And Left And Right Side Sound Insulation
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Drain coolant. See **COOLANT, DRAINING AND FILLING** .
- Remove rear coolant hose from oil cooler.
- Remove radiator coolant hoses from engine using hose clip pliers V.A.G 1921 or VAS 5024.
- Remove wiring harness from Generator and lay to one side.
- Disconnect all electrical wiring from transmission and starter and move clear.
- Tie power steering reservoir on lock carrier.

WARNING:

- **The fuel and the fuel lines in the fuel system can become very hot (danger of scalding.)**
- **The fuel system is also under pressure! Before opening the system, place cloths around the connections. Then carefully loosen the connection to release pressure.**
- **Wear eye and hand protection when performing any type of repair work on the fuel system!**

- Remove fuel supply hose -1- and fuel return hose -2- from fuel lines on cylinder head.
- Remove poly V-belt. See **POLY V-BELT, REMOVING AND INSTALLING** .
- Remove selector lever cable.

See **SELECTOR LEVER CABLE** .

- Remove all other inter-connecting, coolant, vacuum and intake hoses on engine.
- Remove/disconnect all electrical connections as necessary from engine and lay to one side.

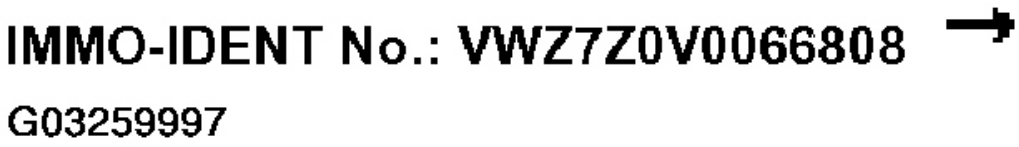

Fig. 7: Removing Fuel Supply Hose And Fuel Return Hose
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove right side axle shaft and disconnect left side axle shaft at transmission:

  See **FRONT AXLE SHAFT** .

- Remove securing clamps for power steering pressure line.
- Remove power steering pump from bracket place to side; hoses remain connected:

  See **POWER STEERING PUMP WITH HYDRAULIC LINES/HOSE** .

- Removing subframe:

  See **SUBFRAME** .

- Remove front exhaust pipe. See **FRONT EXHAUST PIPE AND CATALYST WITH COMPONENTS** .
- Unbolt pendulum support in stated sequence (arrow).

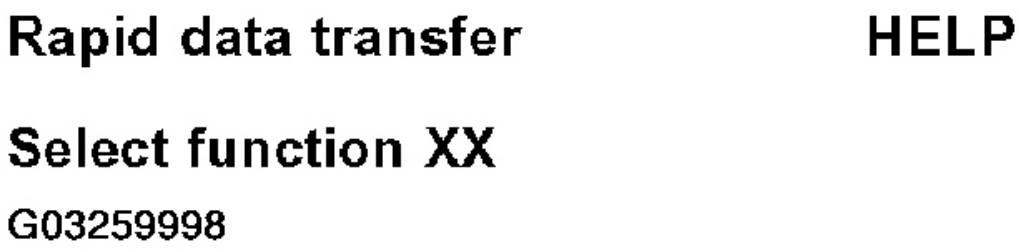

Fig. 8: Removing Pendulum Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with air conditioning

- Observe additional information and removal. See **ADDITIONAL NOTES AND ASSEMBLY STEPS FOR VEHICLES WITH AIR CONDITIONING** .

Continued for all vehicles

- Insert engine bracket T10012 in engine/transmission jack V.A.G 1383 A.

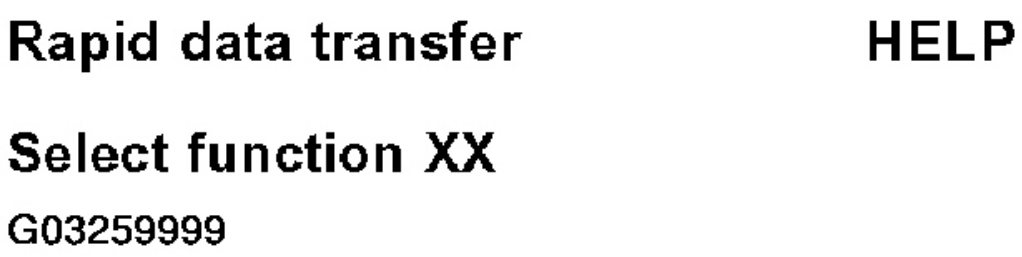

Fig. 9: Inserting Engine Bracket In Engine/Transmission Jack
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove bracket on cylinder block for lower coolant hose. Threaded hole is required to secure engine bracket T10012.
- Secure engine bracket T10012 to cylinder block with securing nuts and bolt M10 X 25 / 8.8 to N.m.
- Lift engine and transmission lightly using engine/transmission jack V.A.G 1383 A.
- Unbolt top of engine bracket (arrows) on engine mounting.

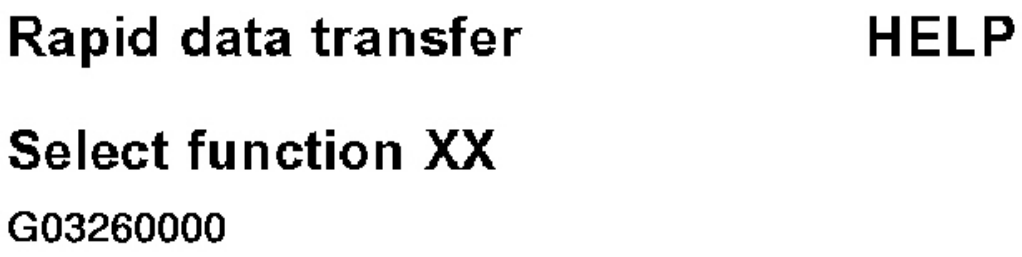

Fig. 10: Removing Top Of Engine Bracket On Engine Mounting

Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: To remove securing bolts, use step ladder VAS 5085.

- Unbolt top of transmissions bracket (arrows -B-) on transmission mounting.

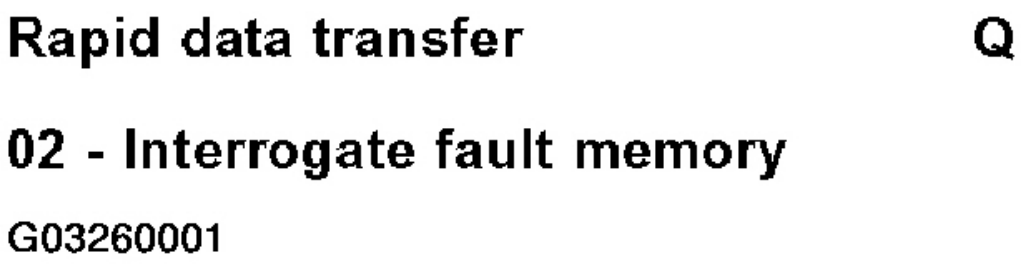

Fig. 11: Removing Top Of Transmissions Bracket On Transmission Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully lower engine and transmission.
- While lowering, guide power steering pressure line past transmission.

NOTE: The engine and transmission must be guided carefully when lowering to prevent damage to the body.

ENGINE, ATTACHING TO ASSEMBLY STAND

NOTE: To work on the engine outside of the vehicle, attach the engine to an assembly stand using the VW 313 holding fixture along with the VW 540 engine/transmission support.

Work sequence

- Transfer engine/transmission subassembly to workbench via engine/transmission jack VAG 1383 A.

Fig. 12: Attaching Engine To Assembly Stand
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lower engine/transmission assembly so that transmission is supported by work bench.
- Remove engine/transmission connecting bolts.
- Push transmission off engine.
- Attach lifting tackle 2024A as follows and lift off engine/transmission jack V.A.G 1383 A using workshop crane.

Fig. 13: Attaching Lifting Tackle And Lift Off Engine/Transmission Jack
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Belt pulley end: 2nd hole on support bar in position 1
- Flywheel end: 4th hole on support bar in position 8

WARNING: Secure ALL hooks and locating pins with lock pins!

NOTE:

- **Positions marked 1 to 4 on the bar must face toward the pulley end of the engine.**
- **The holes in the hook rails are counted up from the hook.**

- Secure engine to holding fixture VW 313 using engine and transmission support VW 540 and supplementary set VW 540/1B.

NOTE: First loosen coolant pipe on flywheel end.

NOTES ON INSTALLING

Installation is performed in reverse order. Note following:

CAUTION: When performing repair work, especially due to the confined conditions in the engine compartment, pay attention to the following.

- **Route all types of hoses/lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant brake fluid and vacuum) as well as electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving hot components.**

- Install intermediate plate onto sealing flange slide onto dowel sleeves (arrows).

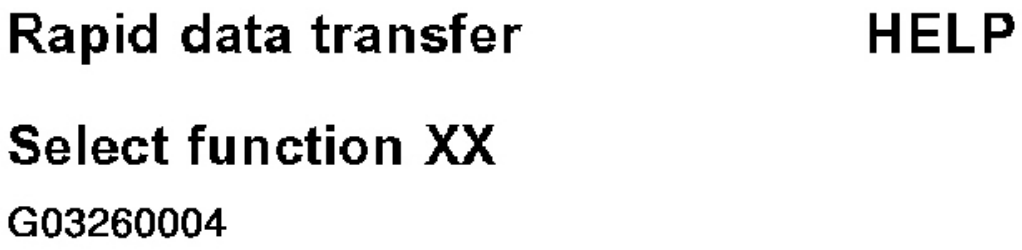

Fig. 14: Installing Intermediate Plate Onto Sealing Flange And Slide Onto Dowel Sleeves
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lightly grease input shaft splines with G 000 grease.
- When installing, make sure that clearance exists between surrounding components.
- Align engine and transmission mountings. See **ENGINE AND TRANSMISSION MOUNTINGS, ALIGNING** .

  Tightening torques. See **ASSEMBLY MOUNTINGS** , assembly mountings.

- Install axle shafts:

See **FRONT AXLE SHAFT** .

- Install front exhaust pipe. See **FRONT EXHAUST PIPE AND CATALYST WITH COMPONENTS** .
- Install assembly.

  See **SUBFRAME** .

- Install selector lever cable.

  See **SELECTOR LEVER CABLE** .

- Installing power steering pump:

  See **POWER STEERING PUMP WITH HYDRAULIC LINES/HOSE** .

- Check electrical connections and routing:

Vehicles with air conditioning

- Install Generator.

  See **GENERATOR** .

- Install air conditioning compressor:

  See **CONDENSER, REMOVING AND INSTALLING** .

Continued for all vehicles

- Install poly V-belt. See **POLY V-BELT, REMOVING AND INSTALLING** .
- Fill with coolant. See **COOLANT, DRAINING AND FILLING** .
- Install center, left and right sound insulation trays:

  See **NOISE INSULATION, ASSEMBLY OVERVIEW** .

- Perform a road test and check Diagnostic Trouble Code (DTC) memory. See **ENGINE CONTROL MODULE (DTC) MEMORY, READING AND ERASING** .

TIGHTENING TORQUES

TIGHTENING TORQUES

Threaded connection	(1) Torque setting
Bolts, nuts	
M6	10 N.m
M7	15 N.m

M8	25 N.m
M10	40 N.m
M12	60 N.m
(1) Deviations from above: Engine to transmission connecting bolts. See **TRANSMISSION** .	

NOTE: Tightening torques for assembly mounting. See ASSEMBLY MOUNTINGS .

ENGINE AND TRANSMISSION MOUNTINGS, ALIGNING

WARNING: Before loosening the bolts, the assembly must be supported with support bar 10-222A.

Engine mounting clearances. See **Fig. 15** .

a = 14.0 mm

b = At least 10.0 mm

Both bolt heads -1- must be in flush with edge -c-.

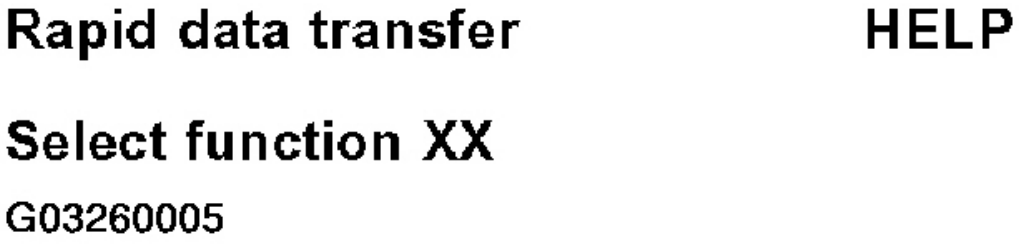

Fig. 15: Identifying Engine Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Transmission mounting clearances. See **Fig. 16** .

Edges -a- and -b- must be parallel with one another.

c = 18 to 20 mm

Rapid data transfer Q

03 - Output Diagnostic Test Mode

G03260006

Fig. 16: Identifying Transmission Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

ASSEMBLY MOUNTINGS

Tightening torques

Engine mounting

1. Mounting to body. ALWAYS replace torque to yield bolts.

   40 N.m plus 90° (1/4 turn)

2. Mounting/bracket to - body

   25 N.m

3. Mounting to engine - mounting

   100 N.m

NOTE: Footnote 1 in Fig. 17 : ALWAYS replace torque to yield bolts.

Fig. 17: Replacing Engine Mounting Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Transmission mounting

1. Mounting to body. ALWAYS replace torque to yield bolts.

   40 N.m plus 90° (1/4 turn)

2. Mounting to body

   25 N.m

3. Mounting to transmission console

   100 N.m

NOTE: Footnote 1 in Fig. 18 : ALWAYS replace torque to yield bolts.

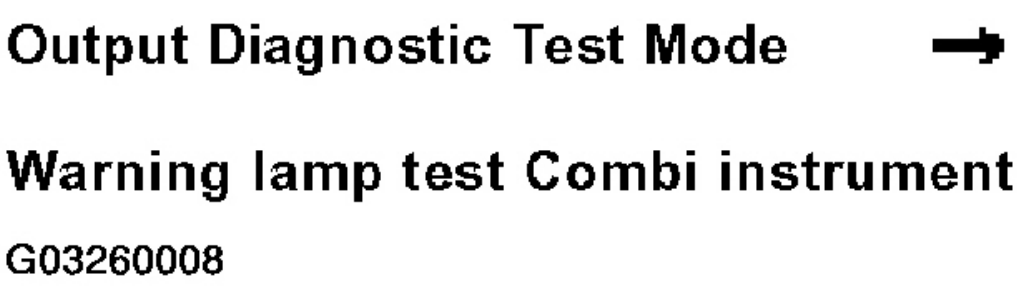

Fig. 18: Replacing Transmission Mounting Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Pendulum support

Installation sequence

1. Pendulum support to subframe. ALWAYS replace torque to yield bolts.

   20 N.m plus 90° (1/4 turn)

2. Pendulum support to transmission. ALWAYS replace torque to yield bolts.

   40 N.m plus 45° (1/8 turn)

3. Pendulum support to transmission. ALWAYS replace torque to yield bolts.

   40 N.m plus 45° (1/8 turn)

NOTE: Footnote 1 in Fig. 19 : ALWAYS replace torque to yield bolts.

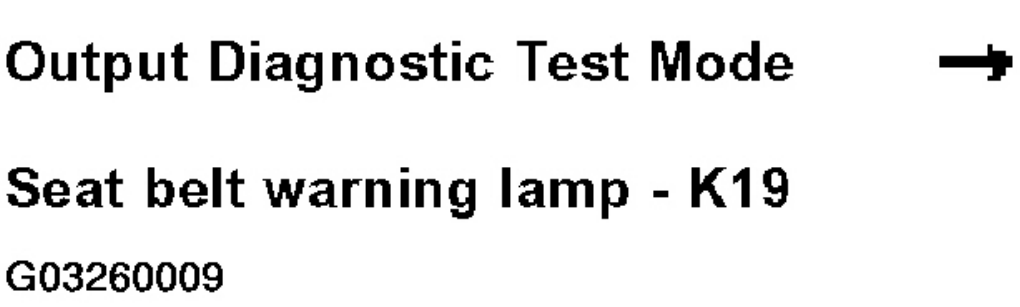

Fig. 19: Installing Pendulum Support Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

ADDITIONAL NOTES AND ASSEMBLY STEPS FOR VEHICLES WITH AIR CONDITIONING

CAUTION: Do not open refrigerant circuit for A/C system.

NOTE: Do not bend or stretch lines or hoses as condenser and/or refrigerant lines/hoses may be damaged.

To remove and install engine without opening refrigerant circuit:

- Remove Generator.

  See **GENERATOR** .

- Remove dipstick guide funnel if necessary.
- Remove air conditioning compressor

  See **CONDENSER, REMOVING AND INSTALLING** .

- Secure A/C compressor to lock carrier so that refrigerant lines/hoses are not stressed.

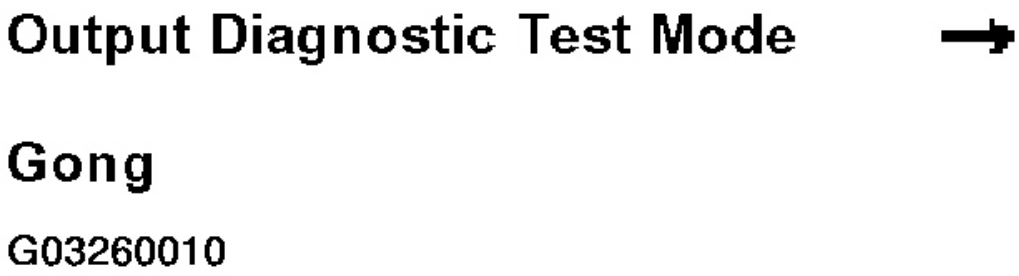

Fig. 20: Identifying A/C Compressor And Refrigerant Lines/Hoses
Courtesy of VOLKSWAGEN OF AMERICA, INC.

ENGINE CRANKSHAFT, CYLINDER BLOCK

ENGINE, DISASSEMBLING AND ASSEMBLING

NOTE: If large quantities of metal particles or other deposits (caused, for example, by partial seizure of the crankshaft or connecting rod bearings) are found in the engine oil, the oil passages must be cleaned thoroughly and the oil cooler replaced in order to prevent further damage.

NOTE: The following list refers to items in Fig. 21 .

I. See **PART I**
II. See **PART II**
III. See **PART III**

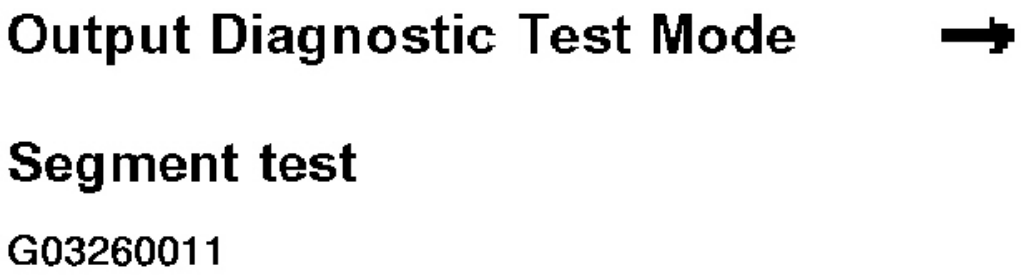

Fig. 21: Disassembling And Assembling View Of Engine
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part I

NOTE: The following list refers to items in Fig. 22 .

1. **Toothed belt guard, upper part**
2. **Toothed belt**
   - Mark direction of rotation before removing
   - Check for wear
   - Do not kink
   - Removing, installing and tensioning. See **TOOTHED BELT, REMOVING AND INSTALLING**
3. **20 N.m plus an additional 1/8turn (45°)**
4. **Tensioning roller**
5. **100 N.m**
6. **25 N.m**
7. **Camshaft pulley**
8. **Hub**
   - With sender wheel
   - Use counter-bracket T10051 to loosen and tighten
   - Use puller T10052 to remove
   - installing and removing. See **CAMSHAFT, REMOVING AND INSTALLING** , removing and installing camshaft
9. **10 N.m**
   - Always replace
10. **Rear toothed belt guard**
11. **Sealing grommet**

- Replace if damaged.

12. **Idler roller**
13. **Coolant pump**
    - Removing and installing. See **COOLANT PUMP, REMOVING AND INSTALLING** .
14. **Crankshaft toothed belt gear**
15. **120 N.m plus an additional 1/4 turn (90°)**
    - Always replace
    - Additional turn can be done in several stages
    - Counterhold with 3099 to loosen and tighten.
    - Do not add oil or grease to threads and shoulder
16. **15 N.m**
17. **20 N.m**
18. **Toothed belt guard, lower part**
19. **Belt pulley/vibration damper**
    - Can only be installed in one position. Holes are offset
20. **10 N.m plus an additional 1/4 turn (90°)**
21. **Cover**
22. **Toothed belt guard, center section**
23. **45 N.m**
24. **Engine bracket**

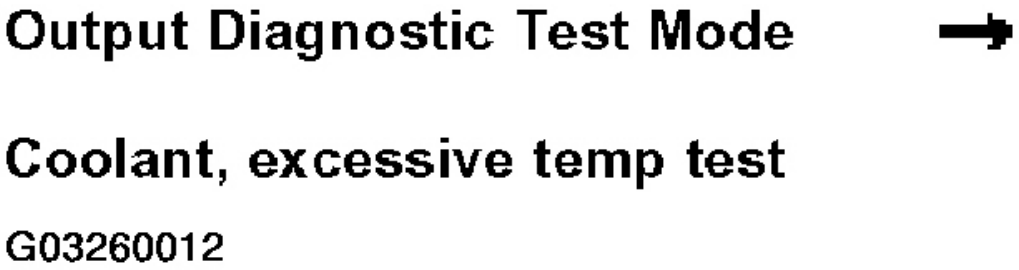

Fig. 22: Identifying Engine Front Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part II

NOTE: The following list refers to items in Fig. 23 .

1. **Poly V-belt**
   - Mark direction of rotation before removing
   - Check for wear
   - Do not kink
   - Removing and installing. See **POLY V-BELT, REMOVING AND INSTALLING**
2. **10 N.m plus an additional 1/4 turn (90°)**
3. **Belt pulley/vibration damper**
   - Can only be installed in one position. Holes are offset
4. **25 N.m**
5. **Tensioning element for poly V-belt**
   - Turn with open end wrench to loosen ribbed belt. See **POLY V-BELT, REMOVING AND INSTALLING**
6. **Generator**
7. **Compact bracket**
   - For Generator, air conditioning compressor and power steering pump
8. **45 N.m**
   - Note tightening sequence. See **Tightening sequence for compact bracket to cylinder block** .
9. **Banjo bolt, 30 N.m**
10. **Seal**
    - Always replace
11. **Pressure line**
12. **Power steering pump**
    - For power steering
    - Removing and installing:

    See **POWER STEERING PUMP: VEHICLES WITH POWER STEERING PUMP IN LOWER SECTION, REMOVING AND INSTALLING** .

13. **Belt pulley**
    - For power steering pump

Fig. 23: Identifying Alternator & Power Steering Pump Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part III

NOTE: The following list refers to items in Fig. 24 .

1. **Cylinder block**
   - Removing and installing sealing flange and flywheel. See **SEALING FLANGES AND FLYWHEEL, REMOVING AND INSTALLING**
   - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING**
   - Disassembling and assembling pistons and connecting rods. See **PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING**
2. **3.5 N.m**
3. **Bracket**
   - For vacuum reservoir
4. **Vacuum reservoir**
5. **40 N.m**
6. **Seal**
   - Always replace
7. **Oil filter bracket**
   - Disassembling and assembling. See **PART 2: DISASSEMBLING OIL FILTER BRACKET**
8. **15 N.m plus an additional 1/4 turn (90°)**
   - Always replace
   - First install upper left and lower right bolt, then tighten four bolts diagonally
9. **15 N.m**
10. **Engine Speed (RPM) sensor -G28-**
11. **Connection union**

- For thermostat

12. **O-ring**
    - Always replace
13. **Thermostat**
    - Removing and installing. See **THERMOSTAT, REMOVING AND INSTALLING** .
    - Observe installation position. See **THERMOSTAT, REMOVING AND INSTALLING** , removing and installing thermostat
    - Checking: Heat-up thermostat in water.
    - Starts to open: approx. 85 °C
    - Ends: approx. 105 °C
    - Opening stroke: min. 7 mm
14. **45 N.m**
    - Note tightening sequence. See **Tightening sequence for compact bracket to cylinder block**
15. **Compact bracket**
    - For Generator, air conditioning compressor and power steering pump
16. **Oil pan**
    - Clean sealing surface before installing.
    - Install with silicone sealant D 176 404 A2. See **OIL PAN, REMOVING AND INSTALLING**

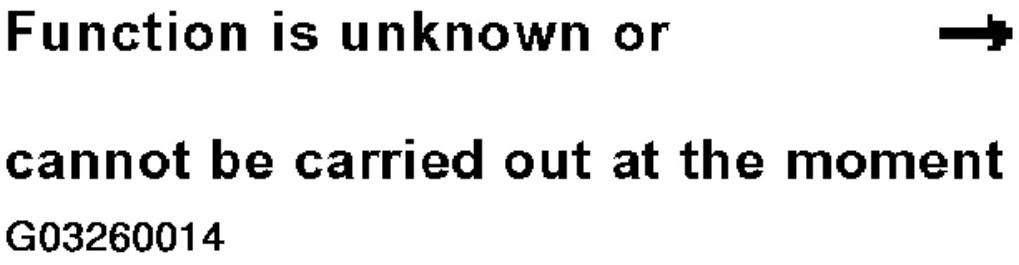

Fig. 24: Identifying External Engine Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Tightening sequence for compact bracket to cylinder block

Tightening Sequence For Compact Bracket To Cylinder Block

Work sequence

- Install compact bracket to cylinder block (observe dowel sleeves between compact bracket and cylinder

block).

- Tighten compact bracket in tightening sequence as follows:

NOTE: The following list refers to items in Fig. 25 .

1. Tighten bolt -A- to 45 N.m.
2. Tighten bolt -B- to 45 N.m.
3. Tighten bolt -C- to 45 N.m.
4. Tighten bolt -D- to 45 N.m
5. Tighten bolt -E- to 45 N.m.
6. Tighten bolt -F- to 45 N.m.

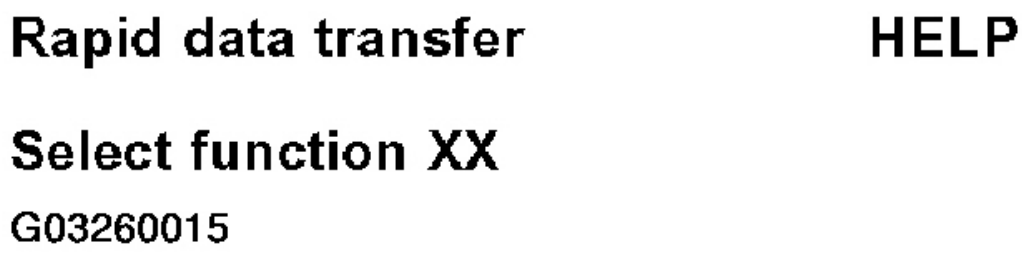

Fig. 25: Tightening Sequence For Compact Bracket To Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Poly V-belt, removing and installing

Special tools and equipment

- T10060 Mandrel

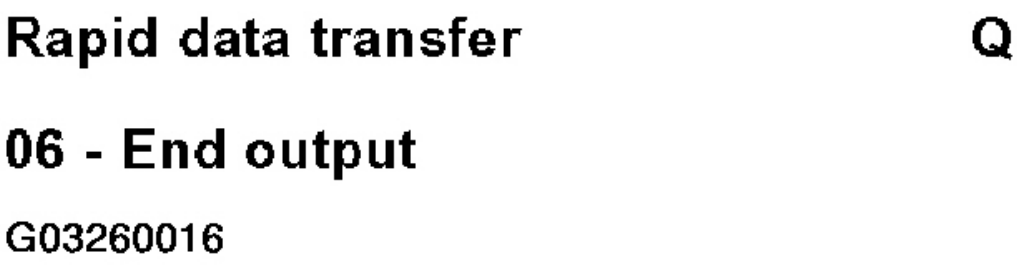

Fig. 26: Identifying Special Tools And Equipment (Mandrel)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove upper charge air line -1- with connecting hose -2-.
- Remove bolt/screw -3- and release connector (arrow).

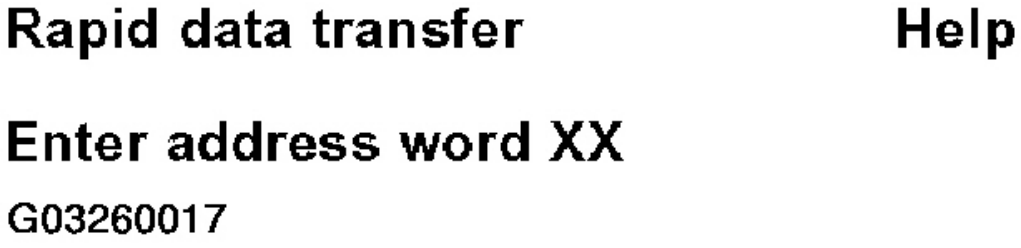

Fig. 27: Removing Upper Charge Air Line -1- With Connecting Hose
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully cover or close open ends.
- Mark direction of rotation of poly V-belt.
- Turn tensioning element in direction of arrow to relieve tension on poly V-belt and lock with mandrel T10060.

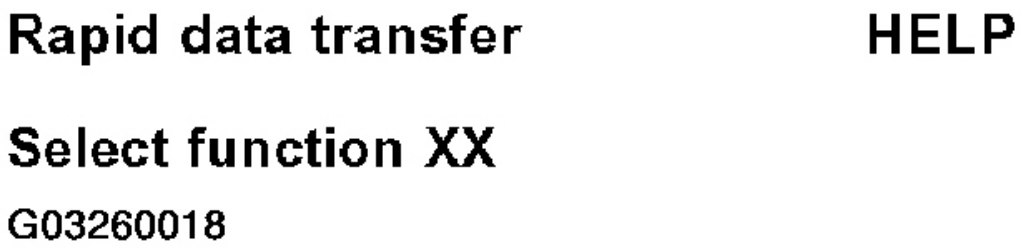

Fig. 28: Turning Tensioning Element In Direction Of Arrow To Relieve Tension On Poly V-Belt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove ribbed belt.

Installing

- Installation is performed in reverse sequence of removal.

NOTE:

- **Before installing poly V-belt, make sure that all ancillaries (Generator, air conditioner compressor, power steering pump) are secured tightly.**
- **When installing poly V-belt, check direction of rotation and proper seating of belt in belt pulleys.**
- **For vehicles which do not have an air conditioning system: place ribbed belt over Generator pulley last.**
- **For models with an air conditioning system: place poly V-belt over A/C compressor last.**
- **When installing upper charge air line lift line connection piece on charge air cooler slightly (engages easier).**

After completing repairs:

- Start engine and check belt running.

Drive belt with no air conditioner compressor

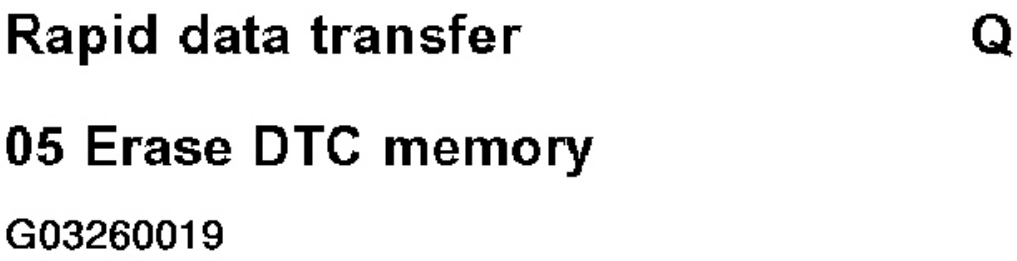

Fig. 29: Identifying Drive Belt Routing With No Air Conditioner Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Drive belt with A/C compressor (double poly V-belt)

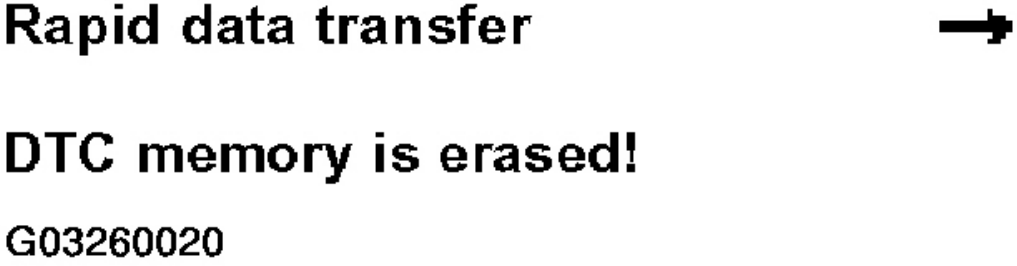

Fig. 30: Identifying Drive Belt Routing With A/C Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

SEALING FLANGES AND FLYWHEEL, REMOVING AND INSTALLING

NOTE: The following list refers to items in Fig. 31 .

1. **Seal**
   - Do not add oil or grease oil seal sealing lip
   - Before installing, remove oil residue from crankshaft journal using a clean cloth
   - Replacing crankshaft oil seal, poly V-belt pulley end. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING**
2. **Sealing-flange belt pulley end**

- Must be located on dowel sleeves.
- Removing and installing. See **SEALING FLANGE - BELT PULLEY END, REMOVING AND INSTALLING** .
- Insert with silicone sealant D 176 404 A2. See **SEALING FLANGE - BELT PULLEY END, REMOVING AND INSTALLING** .

3. **Cylinder block**
   - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING**
   - Disassembling and assembling pistons and connecting rods. See **PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING** .
4. **Flywheel**
   - To remove and install flywheel counterhold with 3067
5. **60 N.m plus an additional 1/4 turn (90°)**
   - Always replace
6. **Intermediate plate**
   - Must be located on dowel sleeves
   - Do not damage/bend when assembling
7. **15 N.m**
8. **Sealing flange with oil seal**
   - Replace complete
   - Do not add oil or grease to oil seal sealing lip
   - Before installing, remove oil residue from crankshaft journal using a clean cloth
   - Use protective sleeve supplied when installing
   - Remove protective sleeve first after sliding sealing flange onto crankshaft journal

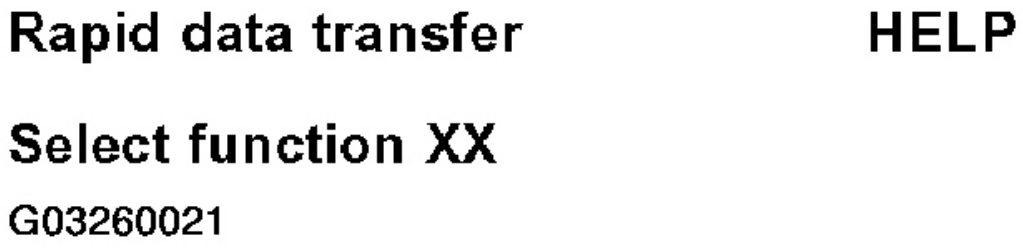

Fig. 31: Removing And Installing Sealing Flanges And Flywheel
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Crankshaft oil seal - pulley end, replacing

Special tools and equipment

- 3099 Counterhold
- 3203 Oil seal extractor
- T10053 Assembly device
- V.A.G 1331 Torque wrench (5 to 50 N.m)
- V.A.G 1332 Torque wrench (40 to 200 N.m)

Fig. 32: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove toothed (timing) belt. See **TOOTHED BELT, REMOVING AND INSTALLING** .
- Remove crankshaft toothed belt gear. To do this counterhold gear with 3099.

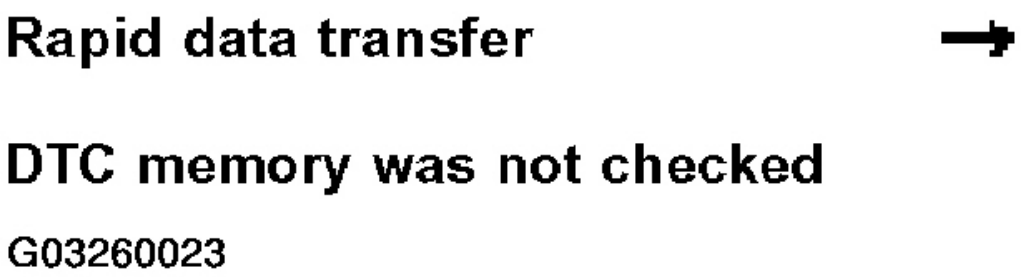

Fig. 33: Removing Crankshaft Toothed (Timing) Belt Gear
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Place two washers between toothed belt gear and counter bracket when

installing the counterhold.

- To guide seal extractor, screw center bolt into crankshaft onto limit stop by hand.
- Unscrew inner part of oil seal extractor 3203 nine turns (approx. 17 mm) out of outer part and lock with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.

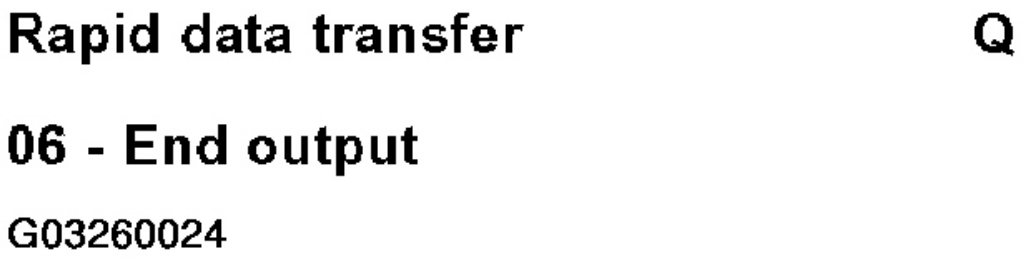

Fig. 34: Loosening Knurled Screw And Turn Inner Part Against Crankshaft To Remove Oil Seal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE: The oil seal sealing lip must not be oiled or greased.

- Remove oil residue from crankshaft journal using clean cloth.
- Install guide sleeve T10053/1 onto crankshaft journal.

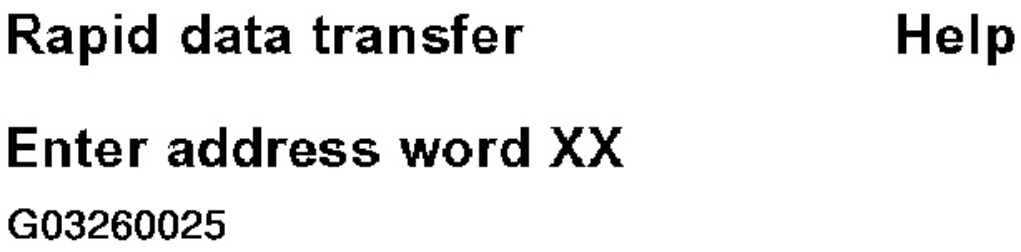

Fig. 35: Installing Guide Sleeve Onto Crankshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve onto crankshaft journal.
- Press in oil seal using press sleeve T10053 and screw T10053/2 (M16 x 1.5 x 60) onto stop.

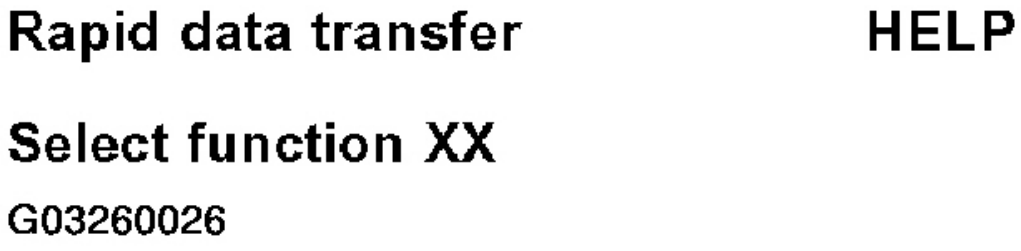

Fig. 36: Installing Crankshaft Toothed Belt Pulley With NEW Center Bolt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install crankshaft toothed belt pulley with new center bolt.
- Install toothed belt. See **TOOTHED BELT, REMOVING AND INSTALLING** .

Sealing flange - belt pulley end, removing and installing

Special tools and equipment

- 3099 Counterhold
- T10053 Assembly device
- V.A.G 1331 Torque wrench (5 to 50 N.m)

- V.A.G 1332 Torque wrench (40 to 200 N.m)
- Hand drill with plastic brush attachment
- D 176 04 A2 Silicone sealant
- Flat scraper

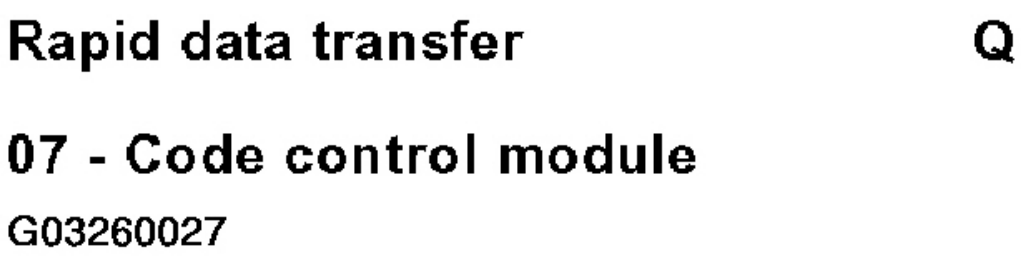

Fig. 37: Checking Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove toothed belt. See **TOOTHED BELT, REMOVING AND INSTALLING** .
- Remove crankshaft toothed belt gear. To do this counterhold gear with 3099.

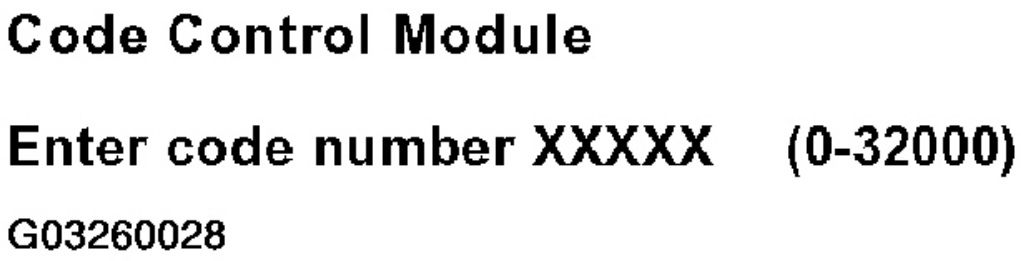

Fig. 38: Removing Crankshaft Toothed (Timing) Belt Gear
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: When installing the counterhold, place two washers between toothed belt gear and counter bracket.

- Drain engine oil.
- Remove oil pan. See **OIL PAN, REMOVING AND INSTALLING** .
- Unbolt sealing flange.
- Remove sealing flange. Release using light blows with a rubber-headed hammer if necessary.
- Remove sealant residue on cylinder block with a flat scraper.
- Remove sealant remains on sealing flange with a rotating plastic brush (wear eye protection).

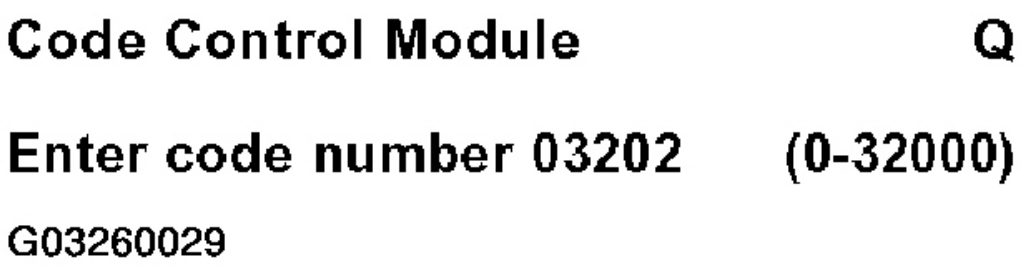

Fig. 39: Removing Sealant Remains On Sealing Flange With Rotating Plastic Brush
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Clean sealing surfaces. They must be free of oil and grease.

Installing

NOTE:

- **Observe the use-by date of the sealing compound.**
- **The sealing flange must be installed within 5 minutes after applying the silicone sealant.**

- Remove oil residue from crankshaft journal using clean cloth.
- Cut off tube nozzle at front marking (nozzle approx. 3 mm diameter).

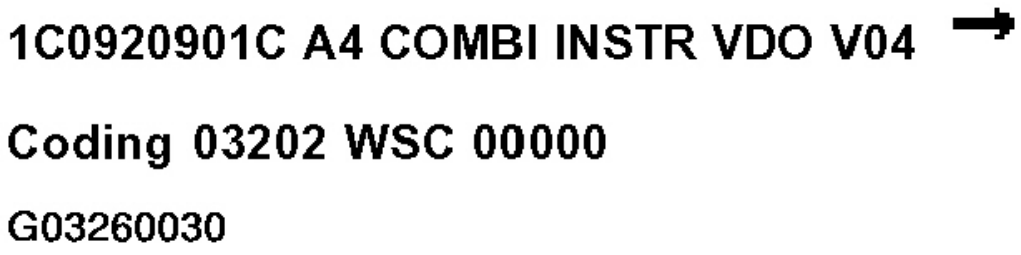

Fig. 40: Cut Off Tube Nozzle At Front
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Apply silicone sealant bead as shown in **Fig. 41** to clean sealing surface of sealing flange.
  - Thickness of sealant bead (arrow): 2 to 3 mm

Fig. 41: Applying Silicone Sealant Bead To Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **The sealing compound bead must not be too thick, otherwise excessive sealing compound will enter the oil pan and may block the suction pipe strainer. It can also drop onto the sealing surface of the crankshaft sealing ring.**
- **Cover the sealing flange sealing surface with a clean cloth before applying the sealant bead.**

- Install sealing flange immediately and lightly tighten all bolts.

NOTE: **Use guide sleeve T10053/1 to install sealing flange with the oil seal already installed.**

- Tighten sealing flange securing bolts using alternate sequence.

  Tightening torque: 15 N.m

- Install oil pan. See **OIL PAN, REMOVING AND INSTALLING** .

NOTE: The sealant must be allowed to cure for approx. 30 minutes after installing the oil pan. Only then fill the engine with oil.

- Install toothed belt. See **TOOTHED BELT, REMOVING AND INSTALLING** .

CRANKSHAFT, REMOVING AND INSTALLING

NOTE: The following list refers to items in Fig. 42 .

1. **Bearing shells 1, 2, 4 and 5**
   - For bearing cap without oil groove
   - For cylinder block with oil groove
   - Do not interchange used bearing shells (mark)
2. **Thrust washers**
   - For bearing cap 3
   - Note fixing arrangement.
3. **65 N.m plus an additional 1/4 turn (90°)**
   - Always replace
   - To measure radial clearance, tighten to 65 N.m, but no further
4. **Bearing cap**
   - Bearing cap 1: Belt pulley end
   - Bearing cap 3 with recesses for thrust washers
   - Bearing shell retaining lugs in cylinder block and bearing caps must align
5. **Bearing shell 3**
   - For bearing cap without oil groove
   - For cylinder block with oil groove
6. **Needle bearing**
   - Driving in and out. See **NEEDLE BEARING IN CRANKSHAFT, REMOVING AND INSTALLING**
7. **Sensor wheel**
   - For Engine Speed (RPM) sensor -G28-
   - Replace if damaged
   - Every time screws are loosened replace sensor wheel
   - Removing and installing. See **Fig. 44**

8. **10 N.m plus an additional 1/4 turn (90°)**
    - Always replace
    - Every time screws are loosened replace sensor wheel
9. **Fitted pin**
    - Checking projection from crankshaft. See **Fig. 43**
10. **Crankshaft**
    - Axial clearance, New: 0.07 to 0.17 mm; Wear limit: 0.37 mm
    - Check radial clearance with Plastigage, New: 0.03 to 0.08 mm; Wear limit: 0.17 mm
    - Do not rotate crankshaft when checking radial clearance
    - Crankshaft dimensions. See **CRANKSHAFT DIMENSIONS**
11. **Thrust washers**
    - For cylinder block, bearing 3

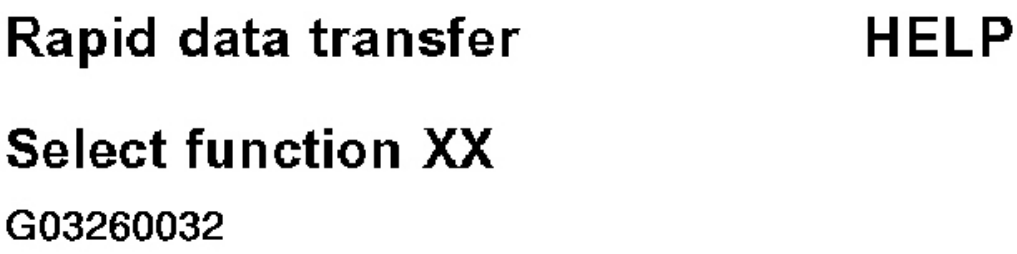

Fig. 42: Explode View Of Crankshaft & Main Bearing Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Crankshaft Dowel Pin Projection, checking

Special tools and equipment

- Depth gauge

Work sequence

- Checking dowel pin projection -a- with a depth gauge when wheel sensor -1- is removed.

  1 - Sender wheel

  2 - Securing bolt

3 - Dowel pin projection -3- out of crankshaft a = 2.5...3.0 mm

Fig. 43: Crankshaft Dowel Pin Projection, Checking
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Sensor wheel, removing and installing

- Replace sensor wheel -2- every time screws -1- are loosened.

  Tightening torque: 10 N.m plus an additional 90° (1/4 turn)

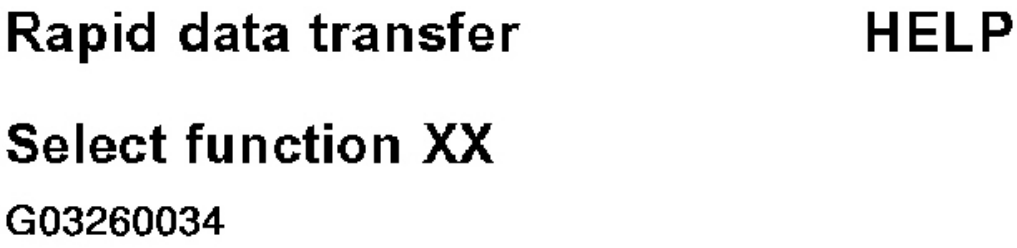

Fig. 44: Proper Installed Height Of Sensor Wheel Screws
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: After securing a second time, the securing points of the countersunk screws in the sensor wheel are deformed in such a way that the bolt heads touch the crankshaft -3- (arrows) and the wheel sensor is located loosely below the screws.

Needle bearing in crankshaft, removing and installing

Special tools and equipment

- Kukko 21/2 and Kukko 22/1
- 3176 Centering mandrel

  or

- Mandrel 207 c

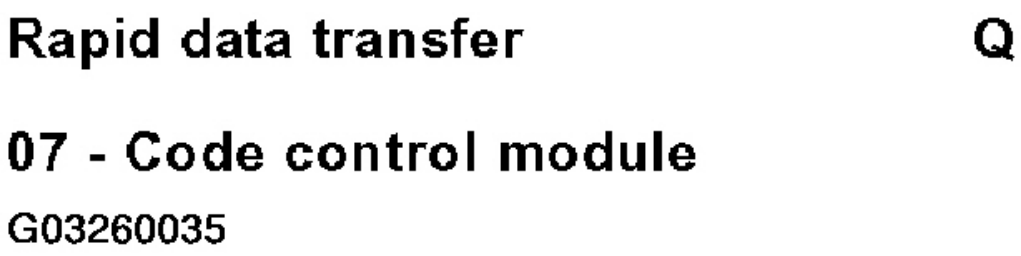

Fig. 45: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

NOTE: Check whether the needle bearing is installed in the crankshaft when installing the engine. Install the needle bearing, if necessary.

- Pull off with extractor -A-, e.g. Kukko 21/2 and Kukko 22/1.

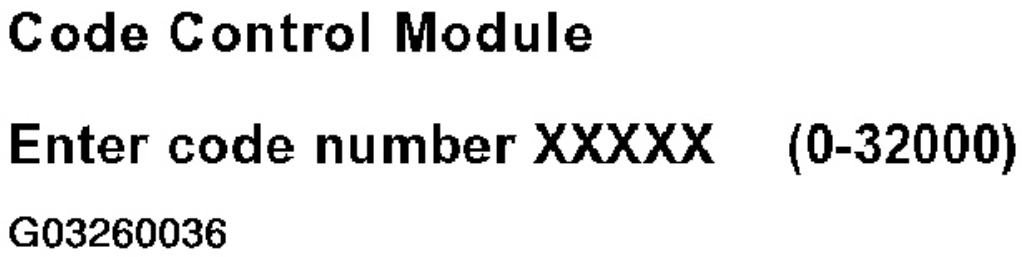

Fig. 46: Removing Needle Bearing From Crankshaft Using Extractor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

- Drive in using punch 207c or centering mandrel 3176.
  - Inscription side of needle bearing must be able to be read when it is installed

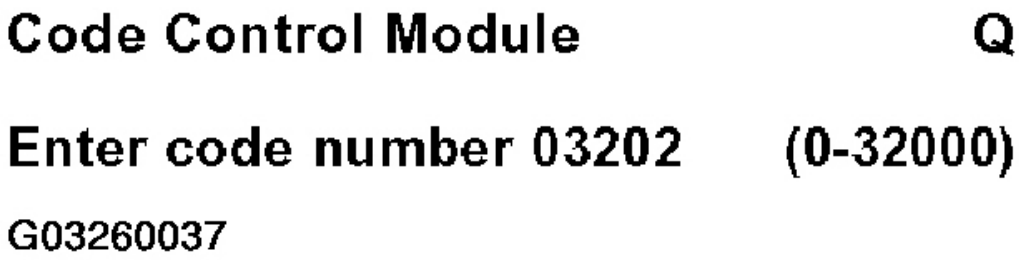

Fig. 47: Driving In Needle Bearing Using Punch 207C
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Locating distance of needle bearing

- Dimension a = 1.7 mm +/- 0.5 mm

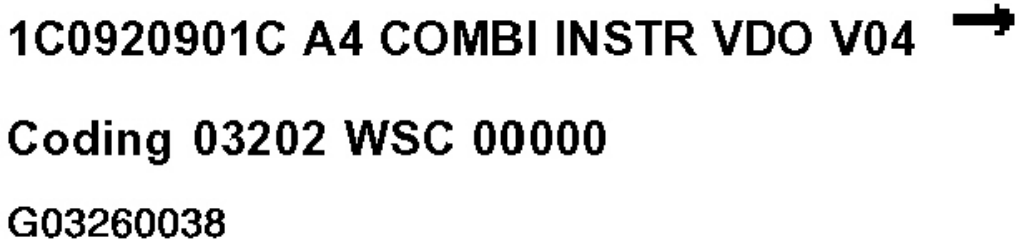

Fig. 48: Locating Needle Bearing Installed Distance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Crankshaft dimensions

NOTE: For CRANKSHAFT DIMENSIONS , all dimensions are in mm.

CRANKSHAFT DIMENSIONS

Honing dimension	Main journal diameter	Connecting rod journal diameter
Basic dimension	-0.022 54.00 -0.042	-0.022 47.80 -0.042
1st undersize	-0.022 53.75 -0.042	-0.022 47.55 -0.042
2nd undersize	-0.022 53.50 -0.042	-0.022 47.30 -0.042
3rd undersize	-0.022 53.25 -0.042	-0.022 47.05 -0.042

PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING

NOTE: The following list refers to items in Fig. 49 .

1. **Piston rings**
   - Offset ring gaps by 120°
   - Position oil scraper ring gap in tight winded spring area
   - Use piston ring pliers to remove and install
   - "TOP" faces toward piston crown
   - Checking ring gap. See **Fig. 50**
   - Checking ring to groove clearance. See **Fig. 51**
2. **Piston**
   - With combustion chamber
   - Mark installation position and cylinder number.
   - Mark installation position and application piston/cylinder. See **Fig. 53**
   - Arrow on piston crown points to belt pulley end.
   - Install using piston ring clamp.
   - Cracks on piston skirt, replace piston
   - Checking piston projection at TDC. See **PISTON PROJECTION AT TDC, CHECKING**
3. **Piston pin**
   - If difficult to remove, heat piston to 60 °C
   - Remove and install with drift VW 222a
4. **Circlip**

5. **Connecting rod**
    - Mark cylinder number -A- with colored pen
    - Installed position: Marking -B- faces pulley end
    - With industrially cracked bearing caps.
6. **Bearing shell**
    - Note installed position. See **Fig. 54**
    - Note versions:
    - Upper bearing shell (to piston) made out of more hard-wearing material
    - Distinguishing features: Black line on contact surface in separating area
    - Do not interchange used bearing shells.
    - Insert bearing shells centrally. See **Fig. 54**
    - Check for secure seating
    - Axial clearance. Wear limit: 0.37 mm
    - Check radial clearance with Plastigage, Wear limit: 0.08 mm
    - Do not rotate crankshaft when checking radial clearance
7. **Cylinder block**
    - Checking cylinder bores. See **Fig. 52**
    - Piston and cylinder dimensions. See **PISTON AND CYLINDER DIMENSIONS**
8. **Connecting rod bearing cap**
    - Note installed position.
    - Caps only install in one position and only on appropriate connecting rod due to breaking procedure (industrially cracking) separating cap from connecting rod
9. **Oil spray jet**
    - For piston cooling.
10. **25 N.m**
    - Insert without sealant
11. **Connecting rod bolt, 30 N.m plus an additional 1/4 turn (90°)**
    - Always replace
    - Oil threads and contact surfaces.
    - To measure radial clearance use old bolts

Fig. 49: Disassembling And Assembling View Of Pistons And Connecting Rods
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking piston ring gap

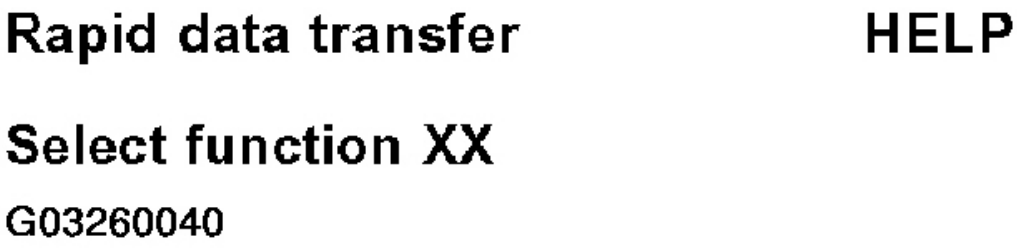

Fig. 50: Checking Piston Ring End Gap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Feeler gauges

- Push ring down squarely from above to approx. 15 mm from bottom end of cylinder.
- 1 gap with feeler gauge.

RING GAP DETERMINING

Piston ring end gap (in mm)	New	Wear limit
1. Compression ring	0.20 to 0.40	1.0
2. Compression ring	0.20 to 0.40	1.0
Oil scraper ring	0.25 to 0.50	1.0

Checking ring to groove clearance

Fig. 51: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Feeler gauges

- Clean ring groove before checking.
- Determine clearance with feeler gauge.

RING TO GROOVE CLEARANCE

Piston ring to groove (in mm)	New	Wear limit
1. Compression ring	0.06 to 0.09	0.25
2. Compression ring	0.05 to 0.08	0.25
Oil scraper ring	0.03 to 0.06	0.15

Cylinder bores, checking

Special tools and equipment

- Internal dial gauge 50 to 100 mm

- Take measurements at 3 positions in both lateral -A- and longitudinal -B- planes, as illustrated. Deviation from nominal dimension max. 0.10 mm

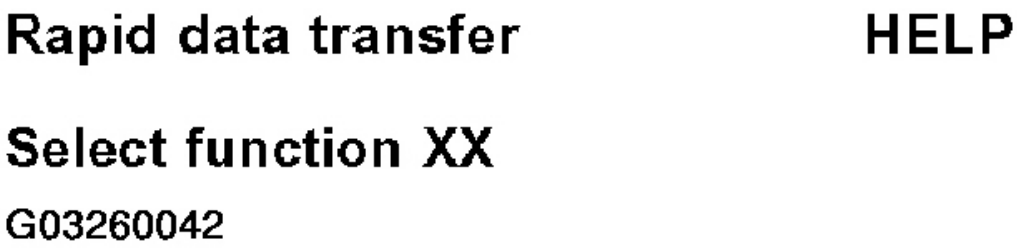

Fig. 52: Checking Cylinder Bores Dimensions
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Measuring the cylinder bores must not be done when the cylinder block is mounted on a repair stand with adapter bracket VW 540, as incorrect measurements would be possible.

Piston installed position and piston/cylinder application

Piston in cylinders 1 and 2:

Larger intake valve chamber toward flywheel (arrows). See **Fig. 53** .

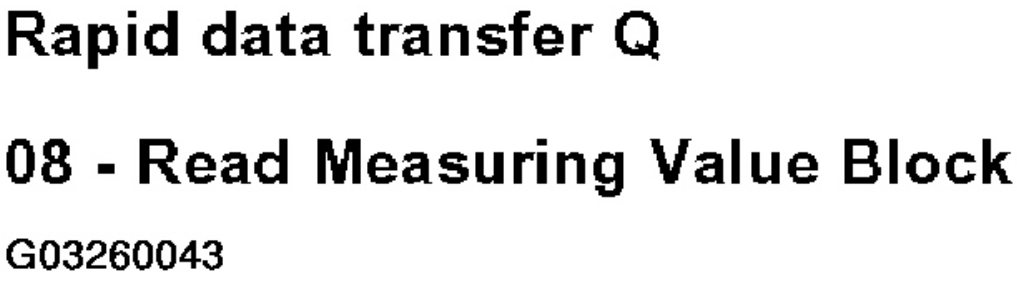

Fig. 53: Locating Larger Intake Valve Chamber Toward Flywheel And Belt Pulley Side
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Piston in cylinders 3 and 4:

Larger intake valve chamber toward belt pulley side (arrows).

NOTE: **New piston/cylinder allocations are shown by a colored marking on the piston crown.**

- **Piston for cylinder 1 and 2: marked 1/2**
- **Piston for cylinder 3 and 4: marked 3/4**

Installed position of bearing shells

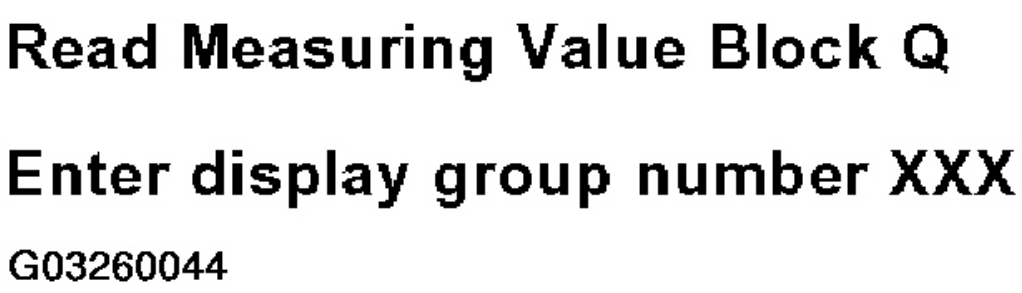

Fig. 54: Identifying Connecting Rod Bearing Cap Shells Dimension -a-
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Center bearing shells when inserting into connecting rod and connecting rod bearing cap.

Dimension -a- must be equal on both left and right sides

Max. deviation: 0.2 mm

Piston projection at TDC, checking

Special tools and equipment

- VW 382/7 Measuring device

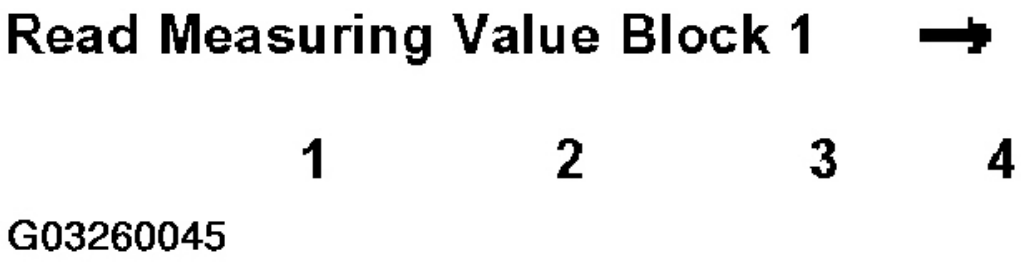

Fig. 55: Identifying Special Tools And Equipment (VW 382/7)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VW 385/17 Final measurement plate
- Dial gauge

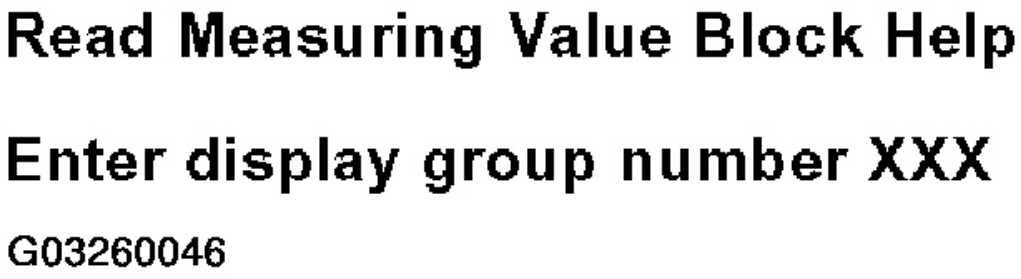

Fig. 56: Identifying Special Tools And Equipment (VW 385/17)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Work sequence

When installing new pistons or a reconditioned engine, the piston projection of all pistons must be checked at TDC. Depending on the piston projection determine the relevant cylinder head gasket to be installed from the following table:

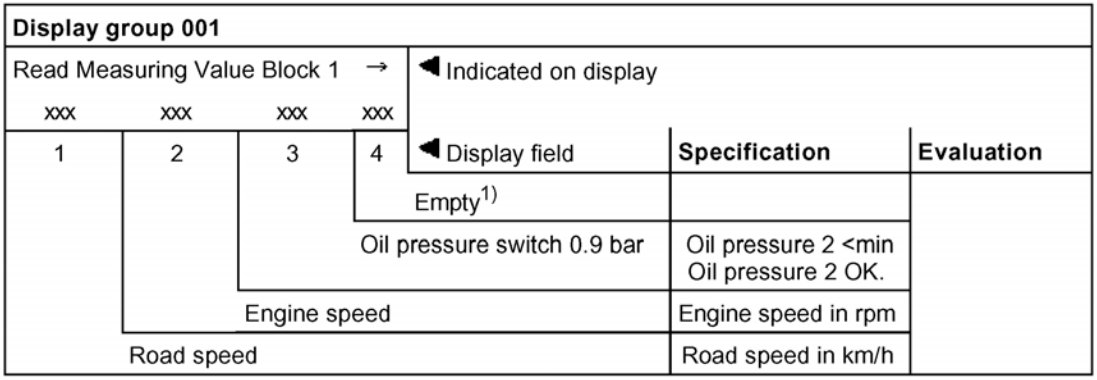

Fig. 57: Measuring Piston Projection At TDC
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: To measure piston projection at TDC turn engine clockwise.

PISTON PROJECTION SPECIFICATIONS

Piston projection	Identification holes/notches
0.91 mm to 1.00 mm	1
1.01 mm to 1.10 mm	2
1.11 mm to 1.20 mm	3

Cylinder head gasket identification

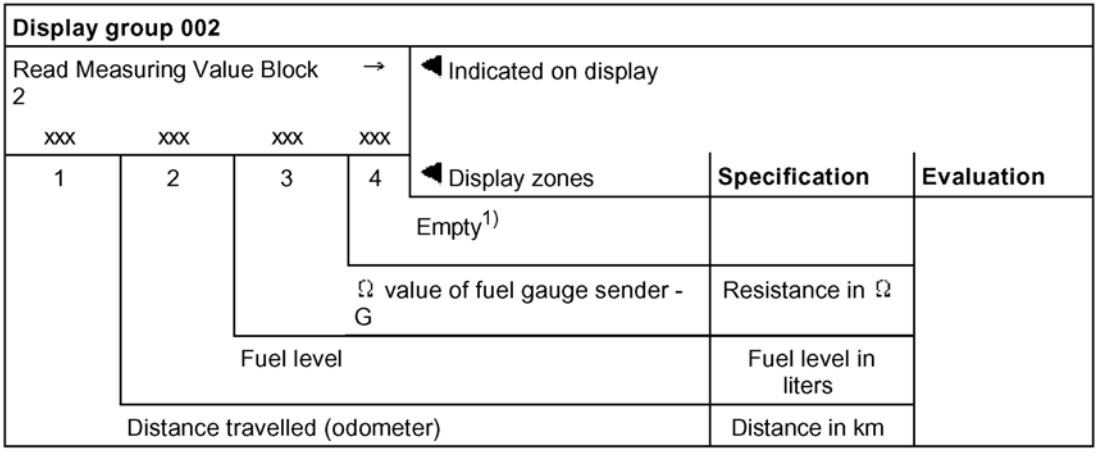

Fig. 58: Cylinder Head Gasket Identification Marks
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Part No. = arrow -1-
- Control code = arrow -2- (not significant!)
- Hole(s) = arrow -3-

NOTE: If differing figures are obtained when measuring the piston projection, the highest figure should be taken when selecting the gasket.

Piston and cylinder dimensions

PISTON AND CYLINDER DIMENSIONS

Honing Dimension (mm)	Piston diameter	Cylinder bore diameter
Basic dimension	79.47	79.51
1st oversize	79.72	79.76
2nd oversize	79.97	80.01

ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD, SERVICING

NOTE:

- **When installing an exchange cylinder head (complete with installed camshafts): Oil the contact surfaces between the lifters and the cam lobes before installing the valve cover.**
- **Do NOT remove the plastic packing pieces which protect the open valves until immediately before installing the cylinder head.**
- **If the cylinder head is replaced, replace all the coolant in the system.**

Checking compression. See **COMPRESSION PRESSURE, CHECKING** .

NOTE: The following list refers to items in Fig. 59 .

1. **Cylinder head cover**
   - Removing and installing. See **CYLINDER HEAD COVER, REMOVING AND INSTALLING**
2. **Pressure regulating valve**
   - For crankcase breather
3. **Vent hose**
   - Via rear charge air pipe to exhaust turbocharger
4. **Cap**
   - Replace seal if damaged

5. **Seal**
    - Replace if damaged.
6. **10 N.m**
    - Observe tightening sequence. See **CYLINDER HEAD COVER, REMOVING AND INSTALLING** .
7. **Cylinder head cover gasket**
    - Replace if damaged or leaking
    - Seal with AMV 174 004 01 before installing. See **CYLINDER HEAD COVER, REMOVING AND INSTALLING** .
    - Insert nubs in cylinder head holes.
8. **20 N.m**
9. **Lifting eye**
10. **Central connector**
    - For unit injector
11. **10 N.m**
12. **From brake booster**
13. **Tandem pump**
    - For fuel and vacuum supply
    - Checking. See **TANDEM PUMP, CHECKING** .
    - Removing and installing, see **TANDEM PUMP, REMOVING AND INSTALLING** .
14. **25 N.m**
15. **Supply hose**
    - From fuel filter, see **FUEL TANK, REMOVING AND INSTALLING** .
    - White or with white marking
    - Check for secure seating
    - Secure with spring-type clips
16. **Return hose**
    - To fuel filter. See **FUEL FILTER, SERVICING** .
    - Blue or with blue marking
    - Check for secure seating
    - Secure with spring-type clips
17. **Seal**
    - Always replace
18. **20 N.m**
19. **Ball head bolt, 8 N.m**
20. **Bracket**
    - For engine cover
21. **Lifting eye**

- With bracket for engine cover

22. **Cylinder head gasket**
    - Always replace
    - Note marking. See **Fig. 61**
    - After replacing, replace entire coolant
23. **20 N.m**
24. **Cylinder head**
    - Check for distortion. See **Fig. 60**
    - Removing and installing. See **CYLINDER HEAD, REMOVING AND INSTALLING** .
    - After replacing, replace entire quantity of coolant.
25. **10 N.m**
    - Always replace
26. **Camshaft Position (CMP) Sensor-G40-**
    - For camshaft position
    - To remove, unclip sealing grommet from rear toothed belt guard
27. **Glow plug**
    - 15 N.m
    - Checking. See **GLOW PLUGS, CHECKING** .
28. **Unit injector**
    - Removing and installing. See **INJECTOR UNIT, REMOVING AND INSTALLING** .
29. **Cylinder head bolt**
    - Note sequence when loosening and tightening. See **CYLINDER HEAD, REMOVING AND INSTALLING** .
    - Before installing, set washers in cylinder head. See **SPECIAL TOOLS AND EQUIPMENT** . item 4, Servicing valve gear

Display group 003						
Read measuring value block 3 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display fields	**Specification**	**Evaluation**
				Empty[1)]		
				Empty[1)]		
				Empty[1)]		
				Engine Coolant Temperature (ECT)	Coolant temperature in ° C	

[1)] Display field blank

G03260049

Fig. 59: Exploded View Of Cylinder Head Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Cylinder head distortion, checking

Display group 050						
Read measuring value block 50 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display fields	**Specification**	**Evaluation**
				Engine Coolant Temperature (ECT)	ECT in ° C	
				Engine oil temperature	Oil temperature in ° C	
				Engine speed	Engine speed in rpm	
				Distance travelled (odometer)	Distance travelled in km	

G03260050

Fig. 60: Checking Cylinder Head Distortion
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Straight edge

- Feeler gauges

Max. permissible distortion: 0.1 mm (minimum distance between linear measurements: 100 mm)

NOTE: Reworking diesel cylinder heads is not permissible.

Cylinder head gasket identification

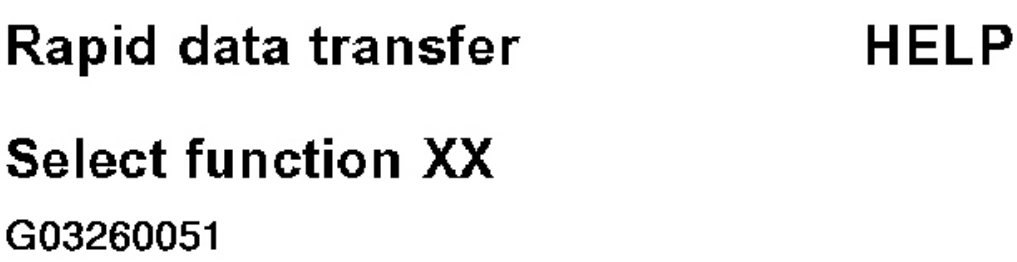

Fig. 61: Identifying Cylinder Head Gasket Control Code And Hole
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Part No. = arrow -1-
- Control code = arrow -2- (not significant!)
- Hole(s) = arrow -3-

NOTE: Different thicknesses of cylinder head gasket are installed depending on the piston projection dimension. When replacing the cylinder head gasket, install a new gasket with the same identification.

Cylinder head cover, removing and installing

Special tools and equipment

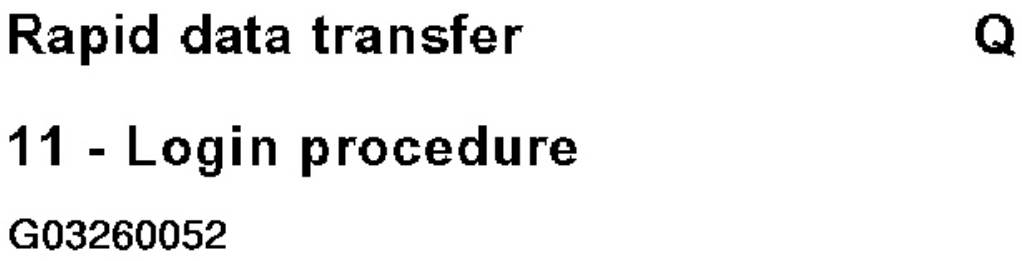

Fig. 62: Identifying Special Tools And Equipment (V.A.G 1331)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- V.A.G 1331 Torque wrench (5 to 50 N.m)
- Sealant AMV 174 004 01

Removing

- Remove engine cover.

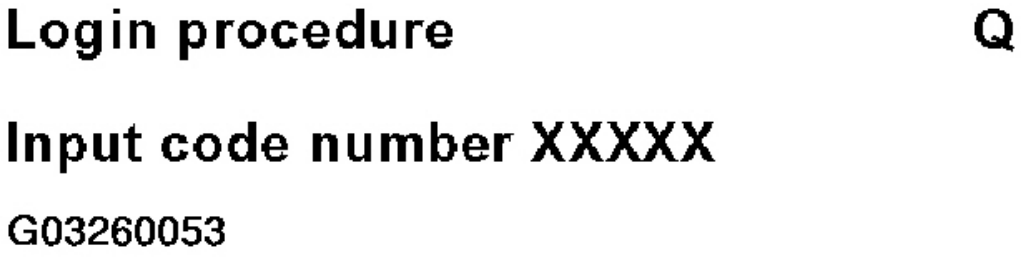

Fig. 63: Removing Engine Cover
Courtesy of VOLKSWAGEN OF AMERICA, INC.

  - Pull front engine cover abruptly upward (arrow -A-) and then pull forward out of rear securing elements (arrow -B-).
- Remove exhaust gas recirculation valve. See **EGR VACUUM REGULATOR SOLENOID VALVE -N18-,REMOVING AND INSTALLING** .
- Remove toothed belt guard upper part.
- Separate crankcase breather hose at union on rear charge air pipe.

- Remove cylinder head cover.

Installing

Installation is performed in reverse sequence of removal. Note the following:

NOTE: Replace cylinder head cover and seals for bolts if damaged.

- Thoroughly clean sealing surfaces using clean cloth.
- Apply a drop of sealant AMV 174 004 01 (diameter approx. 5 mm) to both forward edges of bearing cap/cylinder head sealing surface (arrows).

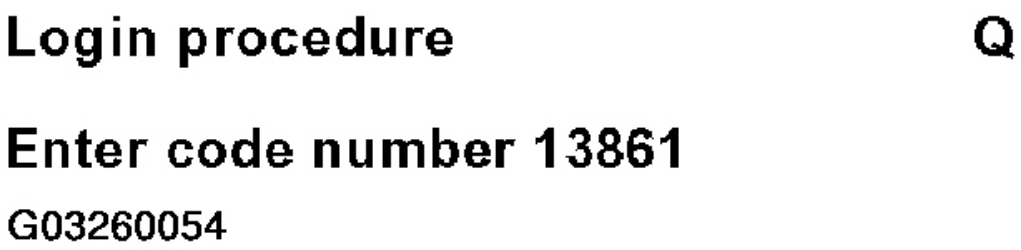

Fig. 64: Identifying Forward Edges Of Bearing Cap/Cylinder Head Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Apply a drop of sealant AMV 174 004 01 (diameter approx. 5 mm) to both back edges of bearing cap/cylinder head sealing surface (arrows).

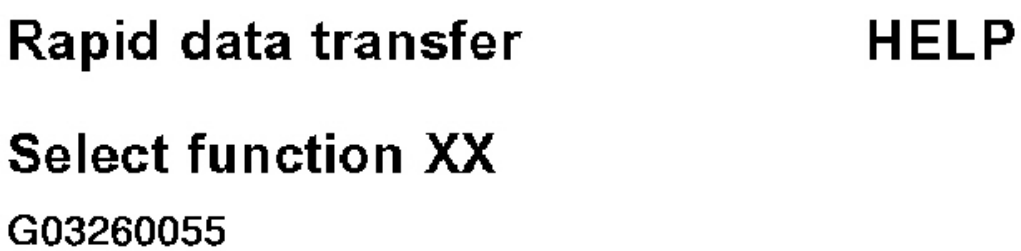

Fig. 65: Identifying Back Edges Of Bearing Cap/Cylinder Head Sealing Surface

Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Position cylinder head.
- Tighten cylinder head cover bolts hand tight in sequence -1- to -13-.
- Tighten bolts in sequence -1- to -13- to 10 N.m.

Fig. 66: Cylinder Head Cover Bolt Tightening Sequence
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install exhaust gas recirculation valve. See **EGR VACUUM REGULATOR SOLENOID VALVE - N18-,REMOVING AND INSTALLING** .

Toothed belt, removing and installing

Special tools and equipment

- 3359 Pin
- T10004 Two-hole pin wrench (or T10020)
- T10115 Pin
- T10050 Crankshaft stop
- V.A.G 1331 Torque wrench (5 to 50 N.m)
- V.A.G 1332 Torque wrench (40 to 200 N.m)

- 10-222A support element with adapter 10-222A/8 (modifying guide 10-222 A/21. See **MODIFYING GUIDE 10-222 A/21 FROM SUPPORT DEVICE 10-222 A** .
- T10004 Two-hole pin wrench (or T10020)
- T10172 Counter-bracket
- T10172/4 Pin

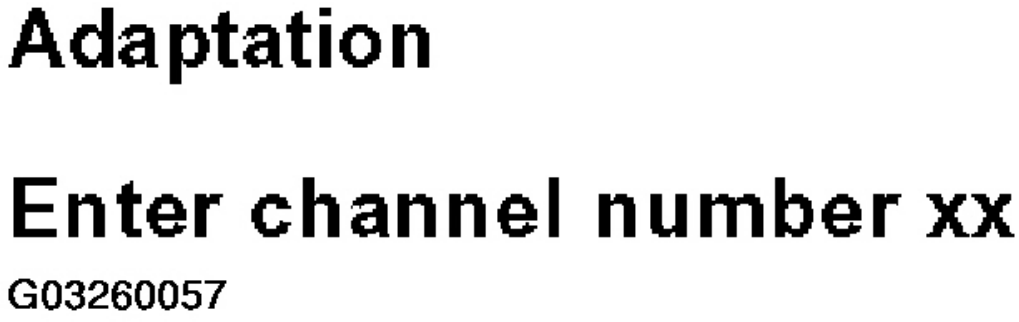

Fig. 67: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

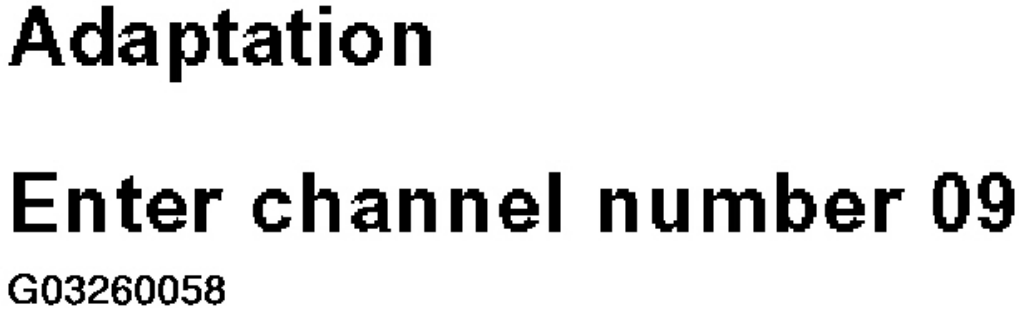

Fig. 68: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Modifying guide 10-222 A/21 from support device 10-222 A

NOTE: A new tensioning roller is gradually being introduced. The tensioning roller has an additional hex bit (arrow). Use a hex key to tighten/loosen toothed belt instead of the two-hole pin wrench T10020 or T10004. This does not change the work sequence.

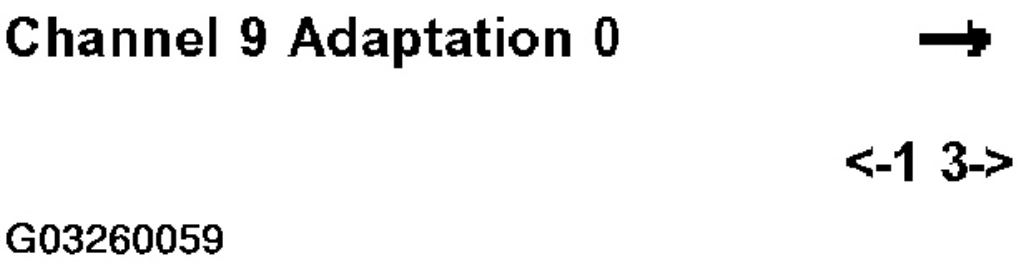

Fig. 69: Identifying Revised Tensioning Roller
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Support device 10-222A is required to support engine/transmission assembly.

A new hole is required on guide 10-222 A/21 to secure adapter 10-222 A/8.

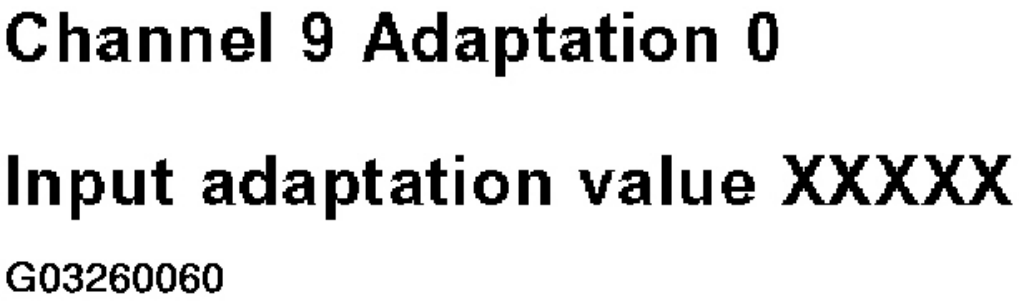

Fig. 70: Identifying Guide
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Dimensions given are in mm.

- Drill a 12.5 mm diameter hole (arrow) in guide 10-222 A/21.

Removing

NOTE: Adjustment work on toothed belts must be performed on cold engines only. The tensioning element indicator position is dependent upon the engine

temperature.

- Remove engine cover.
  - Pull front of engine cover abruptly upward (arrow -A-) and then pull forward out of rear securing elements (arrow -B-).
- Remove poly V-belt. See **POLY V-BELT, REMOVING AND INSTALLING** .
- Remove poly V-belt tensioning element.
- Remove coolant expansion tank (coolant hoses remain connected).
- Remove fuel filter retaining plate.

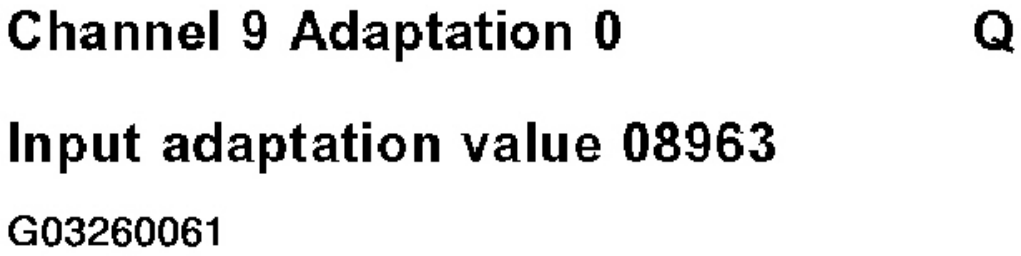

Fig. 71: Removing Engine Cover
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install engine support bracket 10-222A and take up weight of engine in its installed position.

Fig. 72: Installing Engine Support Bracket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove securing bolts from assembly mounting/engine mounting, assembly mounting/body and assembly mounting/body mounting (arrows) and remove assembly mounting complete.

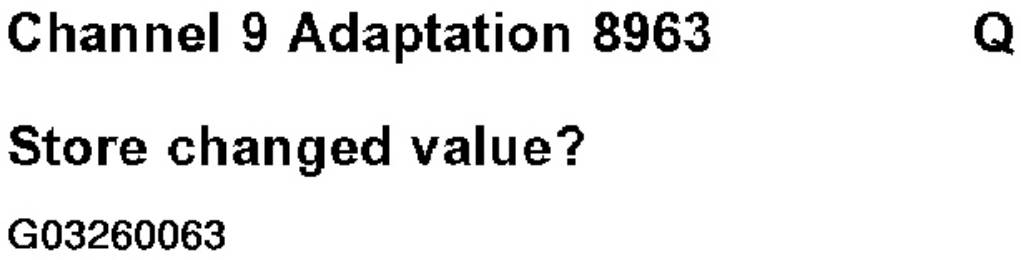

Fig. 73: Removing Securing Bolts From Engine Mounts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **Remove engine mounting when the engine is secured with the support bracket 10-222A.**
- **The engine mounting may only be loosened if the assembly mounting has been removed.**

- Remove toothed belt guard upper part.
- Remove lower charge air pipe -1-.
  - Remove bolt/screw -2- and release connector (arrow).

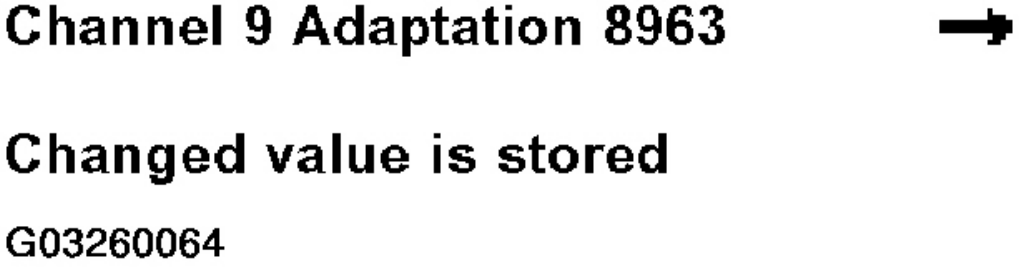

Fig. 74: Removing Lower Charge Air Pipe And Connector
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully cover or close open ends.

- Remove center and right side sound insulation.
- Unbolt engine mounting on cylinder block (arrows) and remove.

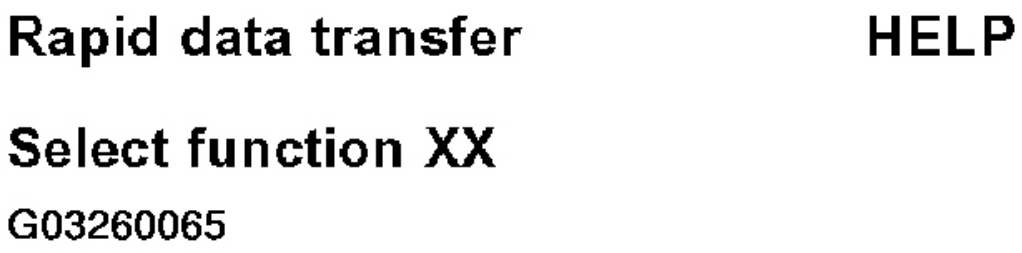

Fig. 75: Removing Engine Mounting On Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **When loosening both upper engine mounting bolts the engine must be raised slightly with the support bracket.**
- **When loosening the front engine mounting bolt the engine must be raised slightly with the support bracket.**

- Remove vibration damper/belt pulley.
- Remove lower and middle toothed belt guards.
- Set crankshaft to TDC No. 1 cylinder.

NOTE:

- **The engine may only be turned over using the crankshaft.**
- **Turn crankshaft in direction of rotation until the marks on the crankshaft toothed (timing) belt sprocket are at the top and (arrow) "4Z" -2- on the toothed belt guard is aligned behind the tabs -1- of the wheel sensor.**

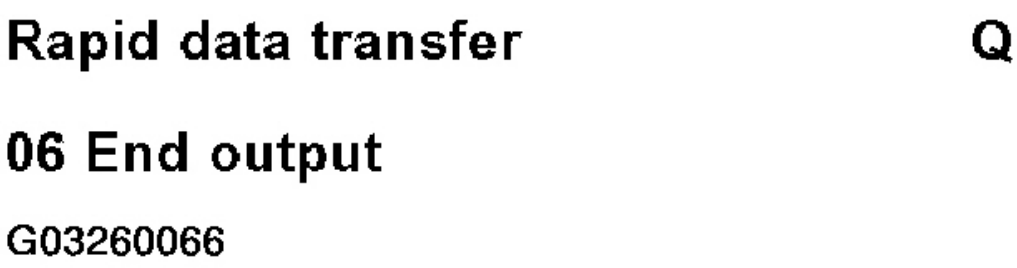

Fig. 76: Aligning Crankshaft Toothed (Timing) Belt Sprocket On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- **In the illustration the camshaft toothed gear is shown without the toothed belt.**

- Lock hub using locking pin 3359. To do this, slide locking pin through free elongated hole on left side and into hole in cylinder head.
- Lock crankshaft toothed belt gear using crankshaft stop T10050. To do this, slide crankshaft stop into teeth of sprocket from front of gear.

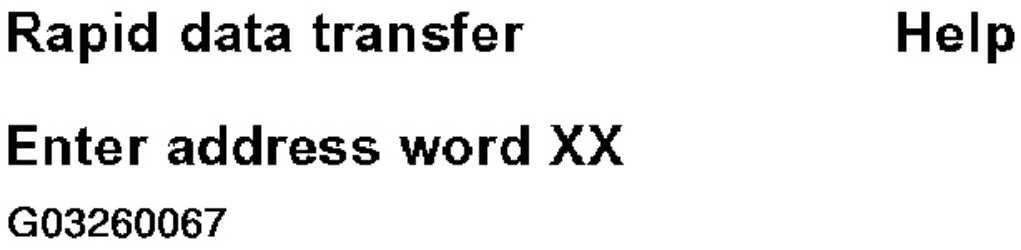

Fig. 77: Aligning Marks On Crankshaft Toothed (Timing) Belt Gear And On Crankshaft Stop
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Marks on crankshaft toothed belt gear -2- and on crankshaft stop -1- must align with one another. The pin of the crankshaft stop must engage in the hole in the sealing flange.

- Mark direction of rotation of toothed belt.
- Loosen camshaft sprocket securing bolts (arrows), until camshaft sprocket can be moved within elongated holes.

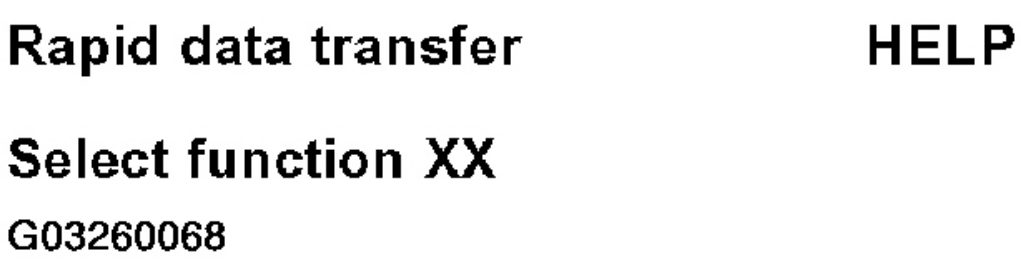

Fig. 78: Loosening Camshaft Sprocket Securing Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen tensioning roller securing nut.
- Turn tensioning roller counter-clockwise with two-hole pin wrench T10020 or T10004 until tensioning roller can be locked with pin T10115. See **Fig. 79** .

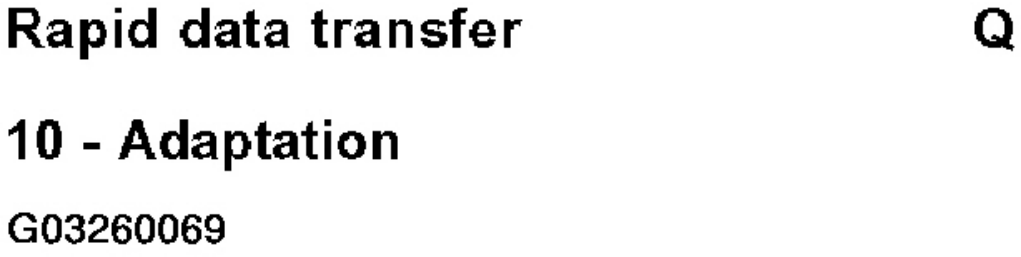

Fig. 79: Turning Tensioning Roller Counterclockwise With Two-Hole Pin Wrench
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn tensioning roller with two-hole pin wrench T10020 or T10004 clockwise onto limit stop and tighten nut -1- by hand.

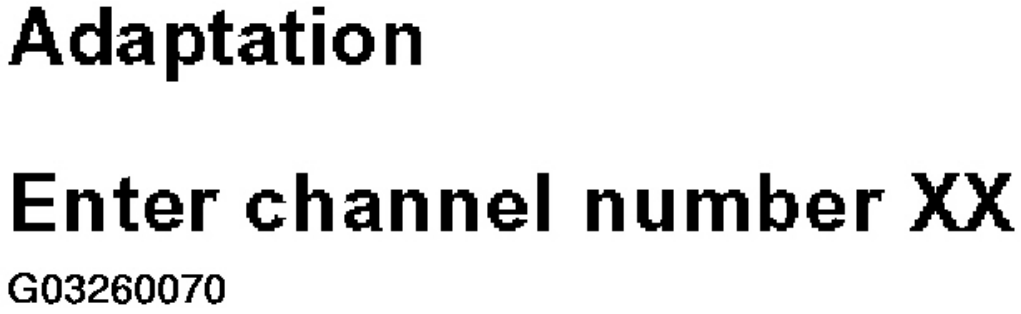

Fig. 80: Turning Tensioning Roller With Two-Hole Pin Wrench Clockwise Onto Limit Stop
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- First remove toothed belt from coolant pump and then from remaining gears.

Installing

Requirements

- Lock camshaft with pin 3359
- Lock crankshaft with crankshaft stop T10050
- Tensioning roller must be installed with pin T10115 and locked right-hand.

NOTE: Adjustment work on toothed belts must be performed on cold engines only. The tensioning element indicator position is dependent upon the engine temperature.

- Turn camshaft gear in elongated holes to centered position (arrow).

Fig. 81: Turning Camshaft Gear In Elongated Holes To Centered Position
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Place toothed belt on crankshaft pulley, tensioning roller, camshaft gear and idler roller.
- Place toothed belt on coolant pump toothed belt gear last.

NOTE: Make sure that tensioning roller seats correctly in rear toothed belt guard (arrow).

Fig. 82: Tensioning Roller Seated In Rear Toothed (Timing) Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen tensioning roller securing nut and pull pin T10115 off.
- Turn tensioning roller with two-hole pin wrench T10020 or T10004 clockwise until indicator aligns over tab in base plate (arrow).

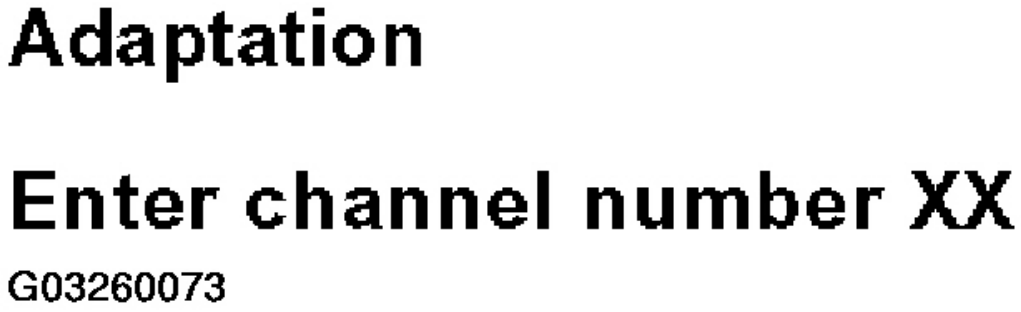

Fig. 83: Turning Tensioning Roller With Two-Hole Pin Wrench
Courtesy of VOLKSWAGEN OF AMERICA, INC.

  - Ensure that securing nut does not turn.
- Hold tensioning roller in this position and tighten tensioning roller securing nut to 20 N.m plus an additional 45° (1/8 turn).
- Insert counterhold T10172 with pin T10172/4 as shown in **Fig. 84** . Press counterhold T10172 in direction of arrow and hold camshaft gear to pretension.

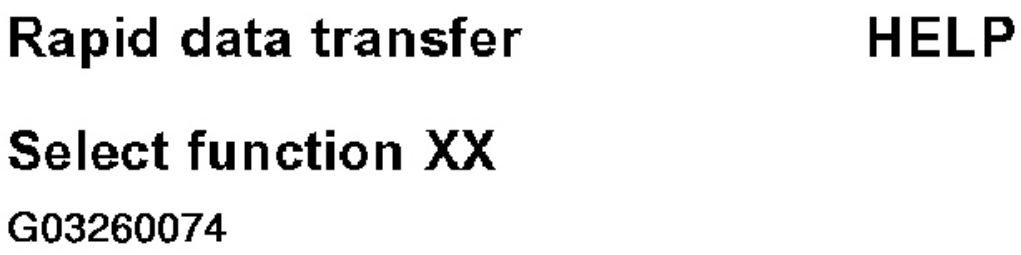

Fig. 84: Inserting Counter-Hold With Pin
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten camshaft pulley securing bolts -1- in this position to 25 N.m.
- Remove pin 3359 and crankshaft stop T10050.
- Turn crankshaft two rotations in engine direction of rotation until crankshaft is set just before TDC No. 1 cylinder.
- Unlock hub with pin 3359 out of engine in direction of rotation.

Fig. 85: Checking Whether Crankshaft Can Be Locked With Crankshaft Stop T10050
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check whether crankshaft can be locked with crankshaft stop T10050.

If crankshaft will not lock:

- Loosen camshaft pulley securing bolts (arrows).

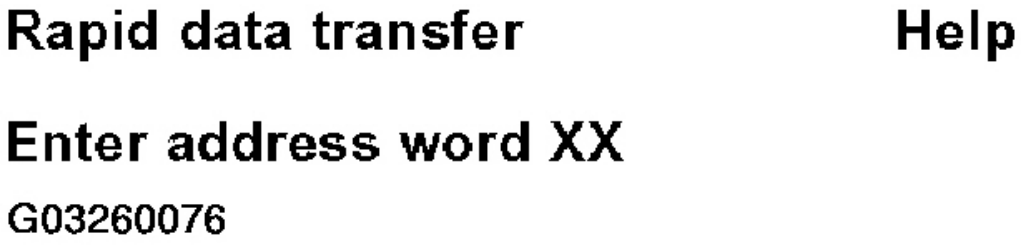

Fig. 86: Loosening Camshaft Pulley Securing Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft slightly against engine direction of rotation until crankshaft stop pin is positioned just before hole in sealing flange (arrow).

Fig. 87: Turning Crankshaft Against Engine Direction Of Rotation Until Crankshaft Stop Pin Is Positioned Just Before Hole In Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft in engine direction of rotation until crankshaft stop pin engages in sealing flange while turning.
- Insert counterhold T10172 with pin T10172/4 as shown. Press counterhold T10172 in direction of (arrow) and hold camshaft gear to pretension.

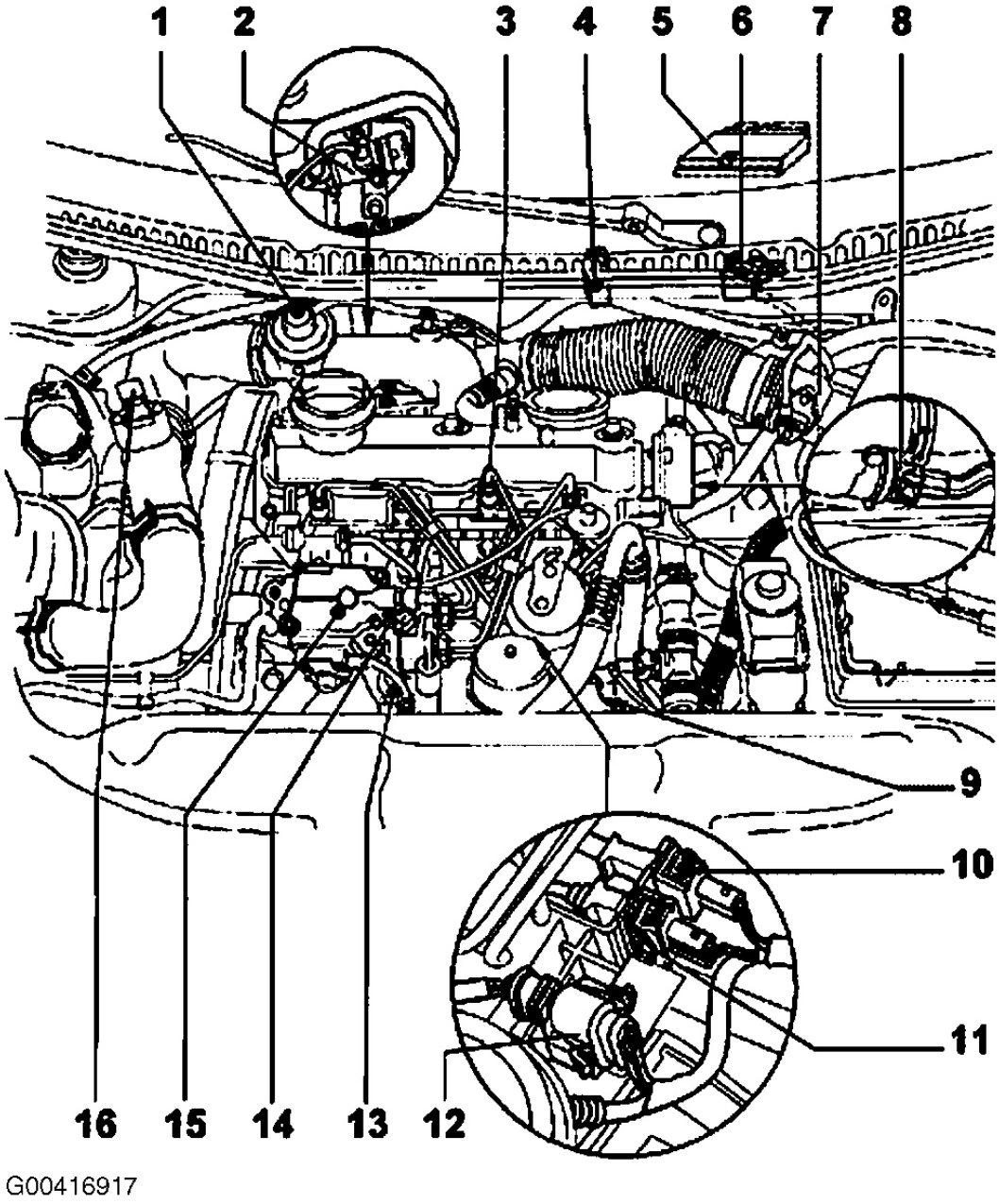

Fig. 88: Inserting Counter-Hold With Pin
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten camshaft pulley securing bolts -1- in this position to 25 N.m.
- Remove pin 3359 and crankshaft stop T10050.
- Turn crankshaft two rotations in engine direction of rotation until crankshaft is set just before TDC No. 1 cylinder.

- Repeat check.
- Install toothed belt guard center and lower parts.
- Install belt pulley/vibration damper.

  Tightening torque: 10 N.m plus an additional 90° (1/4 turn)

- Install engine mounting to cylinder block and tighten (arrows).

  Tightening torque: 45 N.m

NOTE:

- **Insert bolts into engine bracket before installing engine bracket.**
- **Before installing the assembly mounting, all engine mounting bolts must be tightened to prescribed torque.**

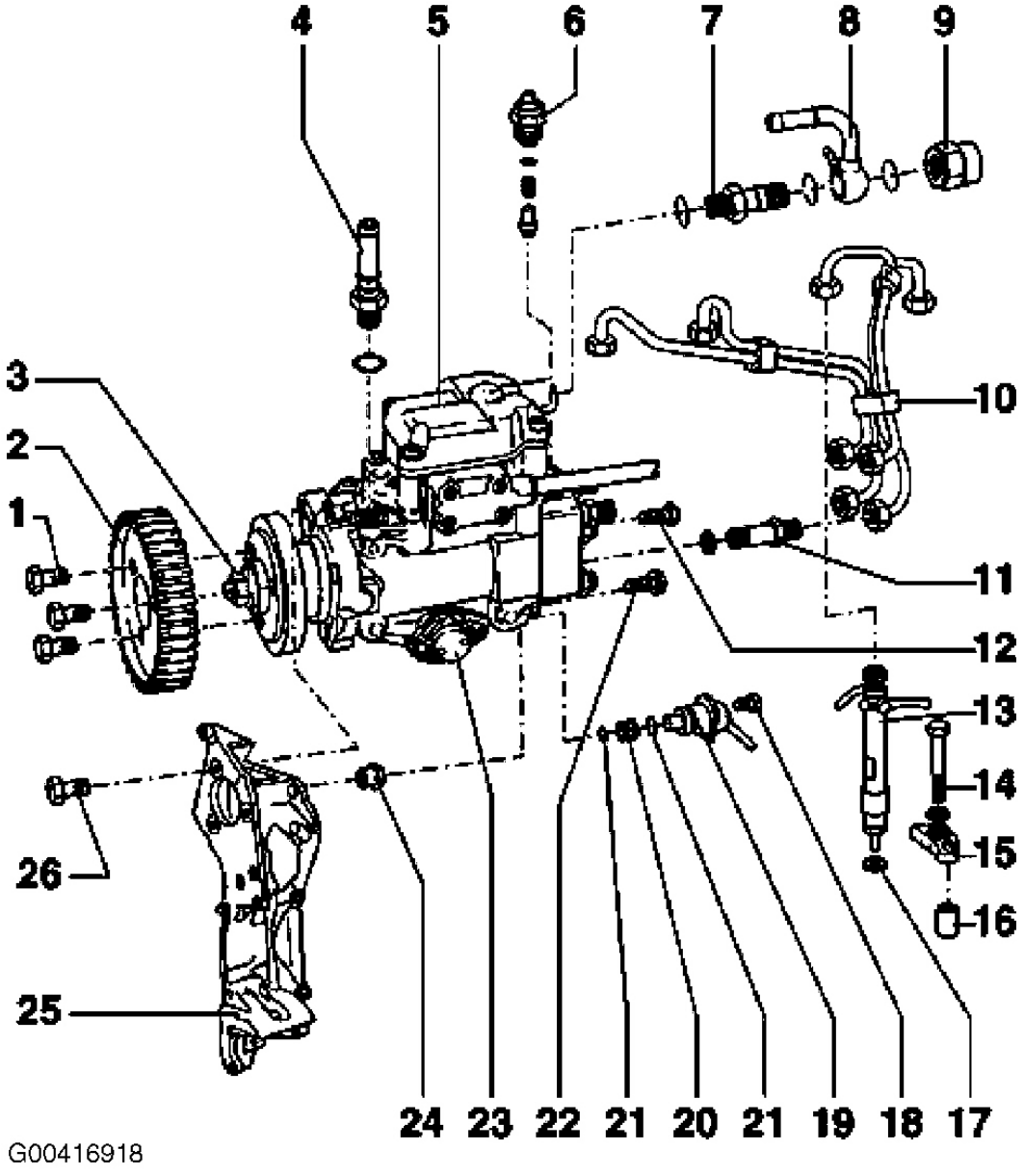

Fig. 89: Installing Engine Mounting To Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install assembly mounting engine/body (replace securing bolts).

  Tightening torque: 40 N.m plus an additional 90° (1/4 turn)

- Align assembly mounting engine side. See **ENGINE AND TRANSMISSION MOUNTINGS,**

ALIGNING .

- Tighten engine mounting to engine bracket. When doing this put contact surfaces on workbench using support device 10-222 A.

  Tightening torque: 100 N.m

- Install engine/body mounting.

  Tightening torque: 25 N.m

- Install toothed belt guard upper part.
- Install fuel filter retaining plate.
- Install coolant expansion tank.
- Install poly V-belt tensioning element.

  Tightening torque: 25 N.m

- Install poly V-belt. See **POLY V-BELT, REMOVING AND INSTALLING** .
- Install engine cover.
- Install center and right side sound insulation.
- Install lower charge air pipe.

Cylinder head, removing and installing

Special tools and equipment

- V.A.G 1306 Drip tray for VAG1202A
- V.A.G 1331 Torque wrench (5 to 50 N.m)
- V.A.G 1332 Torque wrench (40 to 200 N.m)
- V.A.G 1390 Vacuum pump
- V.A.G1390/1 Fluid receptacle
- T10014 Engine support
- 1010-222 A/2 Hook

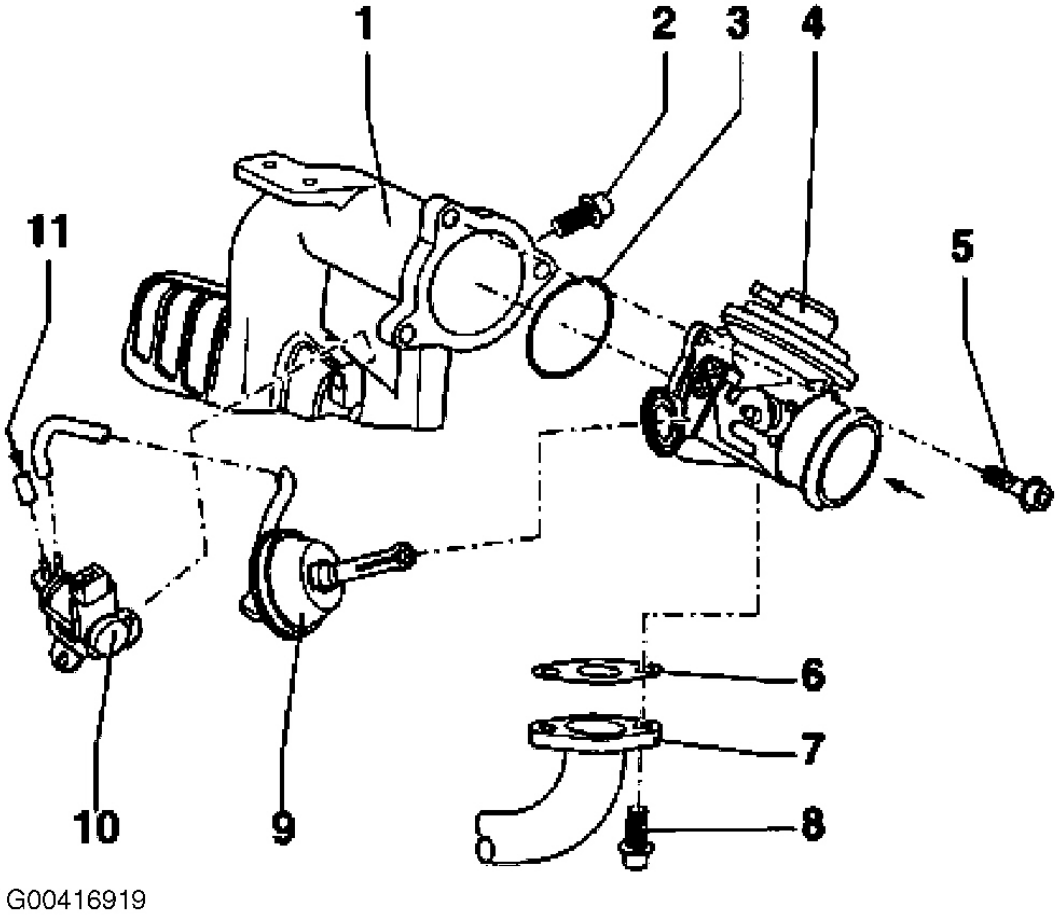

Fig. 90: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

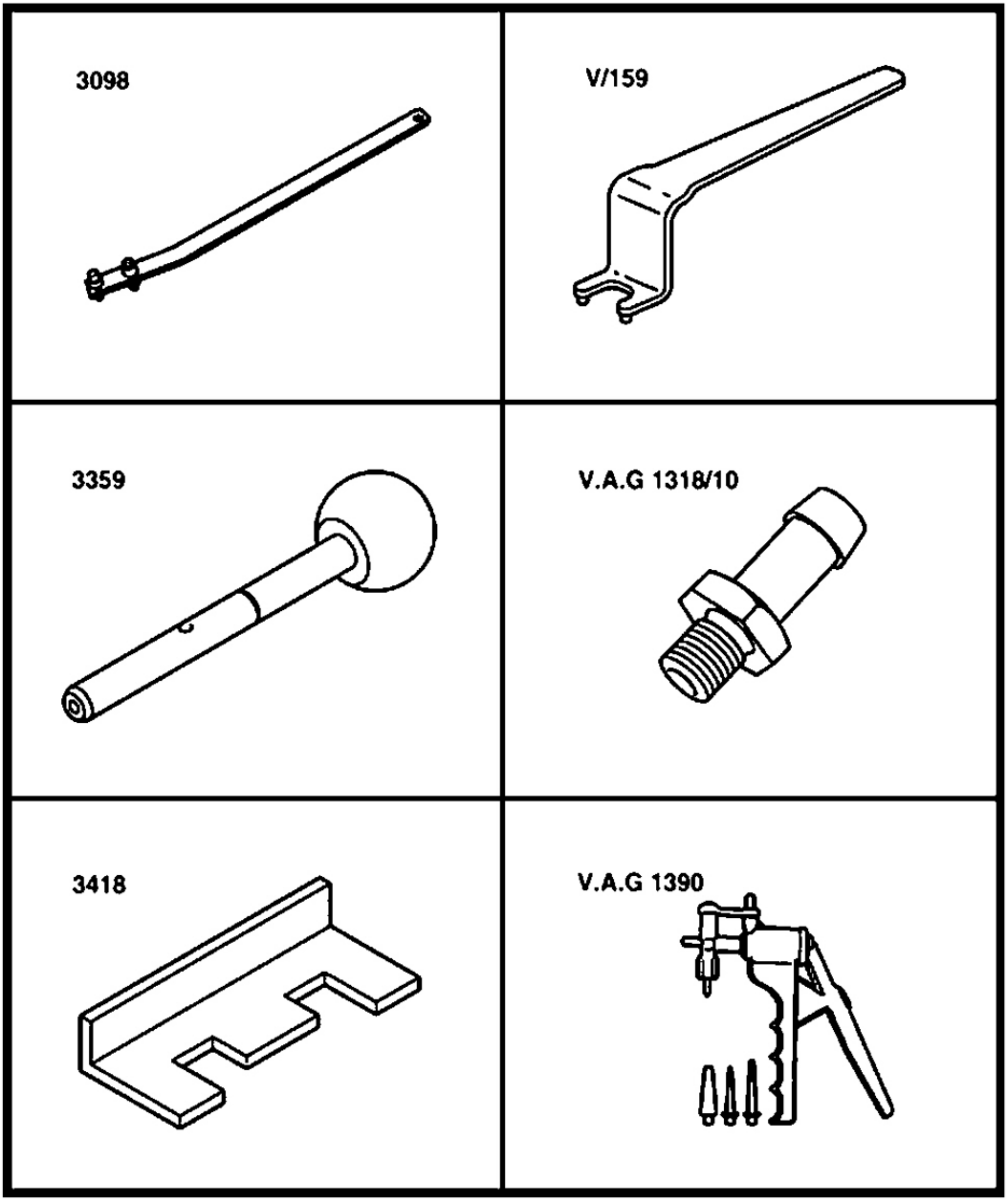

Fig. 91: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

CAUTION: When performing repair work, especially due to the confined conditions in

the engine compartment, pay attention to the following:

- **Route all types of hoses/lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum) as well as electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

- Check whether a coded radio is installed. If installed obtain anti-theft coding.
- With ignition switched off disconnect battery Ground (GND) strap.
- Remove air cleaner housing with intake hose.
- Drain coolant. See **COOLANT, DRAINING AND FILLING** .

WARNING:

- **The fuel and the fuel lines in the fuel system can become very hot (danger of scalding).**
- **The fuel system is also under pressure! Before opening the system, place cloths around the connections. Then carefully loosen the connection to release pressure.**
- **Wear eye and hand protection when performing any type of repair work on the fuel system!**

- Extract fuel from tandem pump. See **TANDEM PUMP, REMOVING AND INSTALLING** .
- Remove/separate connections for glow plugs, fuel temperature sensor, unit injectors (central connector) and coolant temperature sensor.
- Remove fuel hoses and coolant hose off lines on cylinder head (arrows).

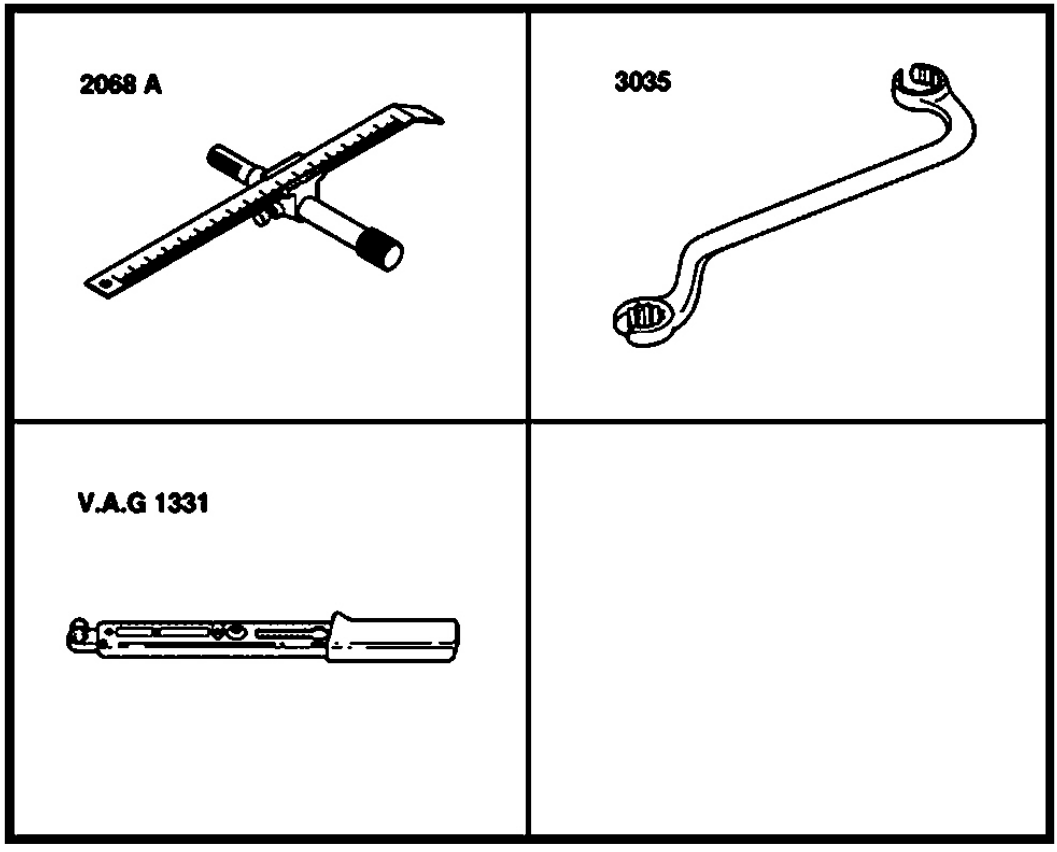

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Fig. 92: Removing Coolant Hose And Connectors From Line Union
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove coolant hose -1- and connectors -2- from line union.
- Remove hose from vacuum reservoir.
- Remove plenum chamber cover (outer) and plenum chamber sealing part.

See **PLENUM CHAMBER SEALING ASSEMBLY, REMOVING AND INSTALLING** .

- Separate quick-release coupling on right side at heat exchanger (from exhaust gas heat exchanger).
- Separate hose connections -1- on non-return valve -3- and to vacuum reservoir.
- Pull union -2- off brake booster.

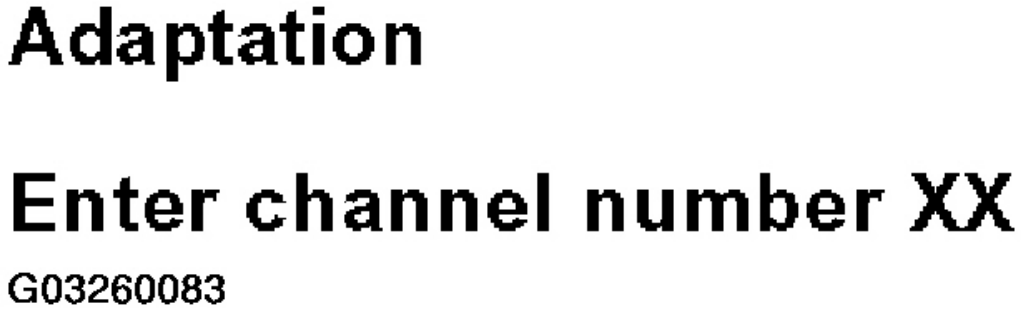

Fig. 93: Hose Connections On Non-Return Valve, Vacuum Reservoir & Brake Booster
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Separate vacuum hoses for vacuum hoses of bypass flap (AGR cooler), of intake manifold and turbocharger at unions.
- Remove front exhaust pipe. See **EXHAUST SYSTEM COMPONENTS, REMOVING AND INSTALLING** .
- Disconnect connector -1-. See **Fig. 94** .
- Remove connecting hose -7-.
- Pull vacuum hose -5- off rear charge air pipe -6-. See **Fig. 94** .
- Separate connecting hose at rear charge air pipe -6- and remove it.
- Disconnect oil return line -2- from union on cylinder block. See **Fig. 94** .
- Remove bolts -3- and -4- and take off bracket. See **Fig. 94** .

Fig. 94: Removing Components Of Cylinder Head Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Disconnect oil supply line at oil filter bracket (arrow) and at coolant pipe.

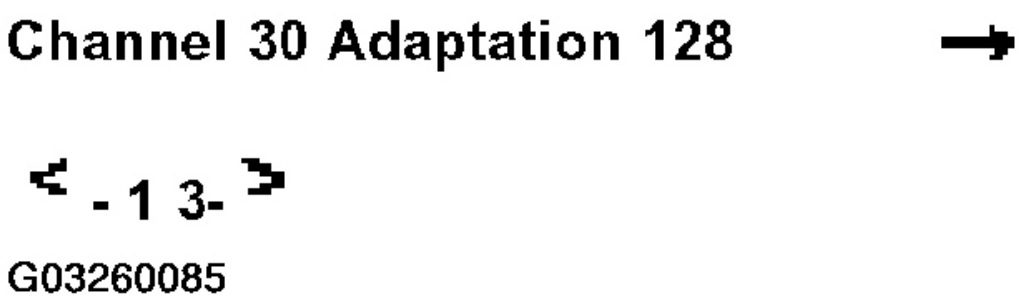

Fig. 95: Disconnecting Oil Supply Line At Oil Filter Bracket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Disconnect oil supply line at exhaust gas turbocharger and exhaust manifold (arrows) and move aside.

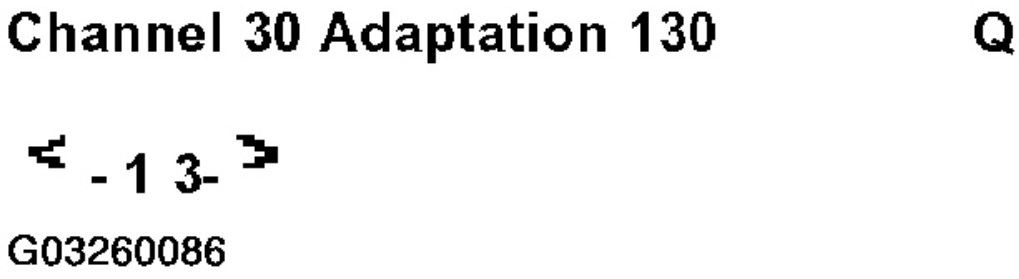

Fig. 96: Disconnecting Oil Supply Line At Exhaust Gas Turbocharger And Exhaust Manifold
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove toothed belt. See **TOOTHED BELT, REMOVING AND INSTALLING** .

NOTE:

- **Both lifting eyes for the support are located on the cylinder head, an additional bracket for supporting the engine must be secured on the cylinder block.**
- **Hook spindle -B- onto cylinder head.**

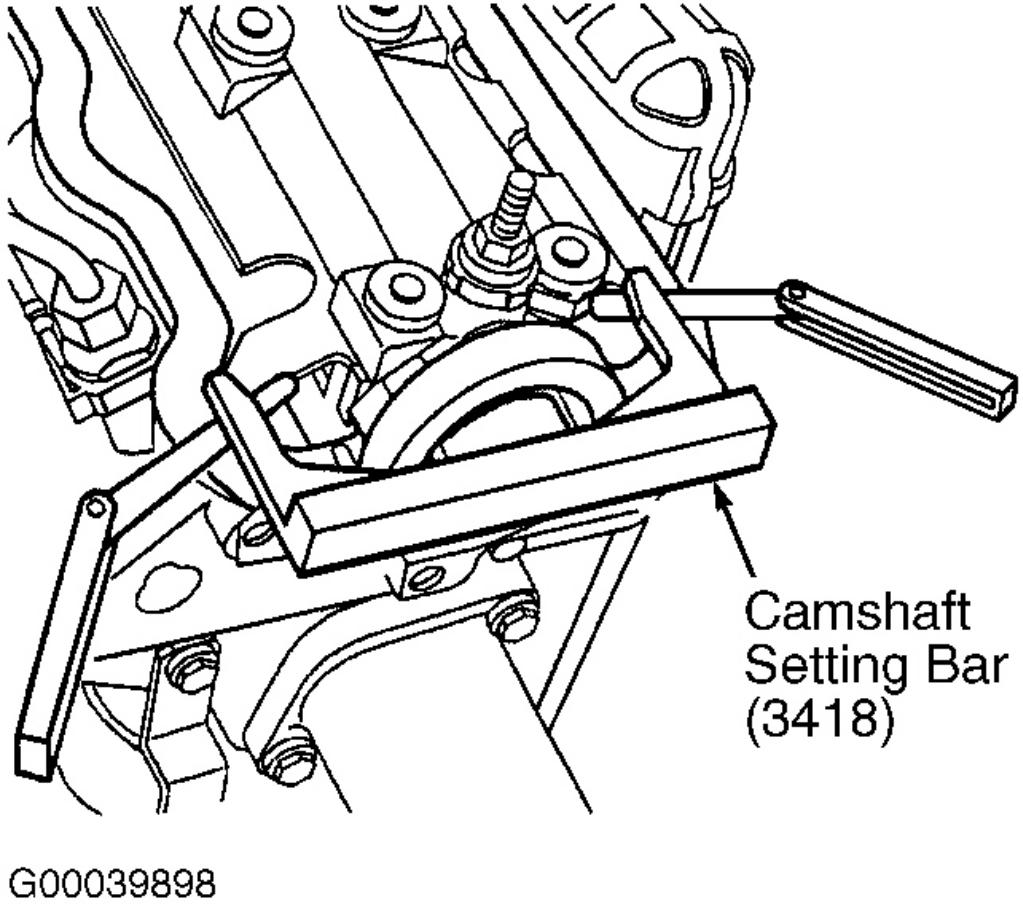

Fig. 97: Attaching Engine Support Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft back slightly.
- Remove camshaft sprocket hub. See **CAMSHAFT, REMOVING AND INSTALLING** .
- Remove toothed belt tensioning roller.
- Remove coolant pump and idler roller.
- Remove Camshaft Position (CMP) sensor.
- Remove rear toothed belt guard.
- Bolt bracket T10014 in forward threaded hole of removed engine bracket in area of water pump in cylinder block, as shown.

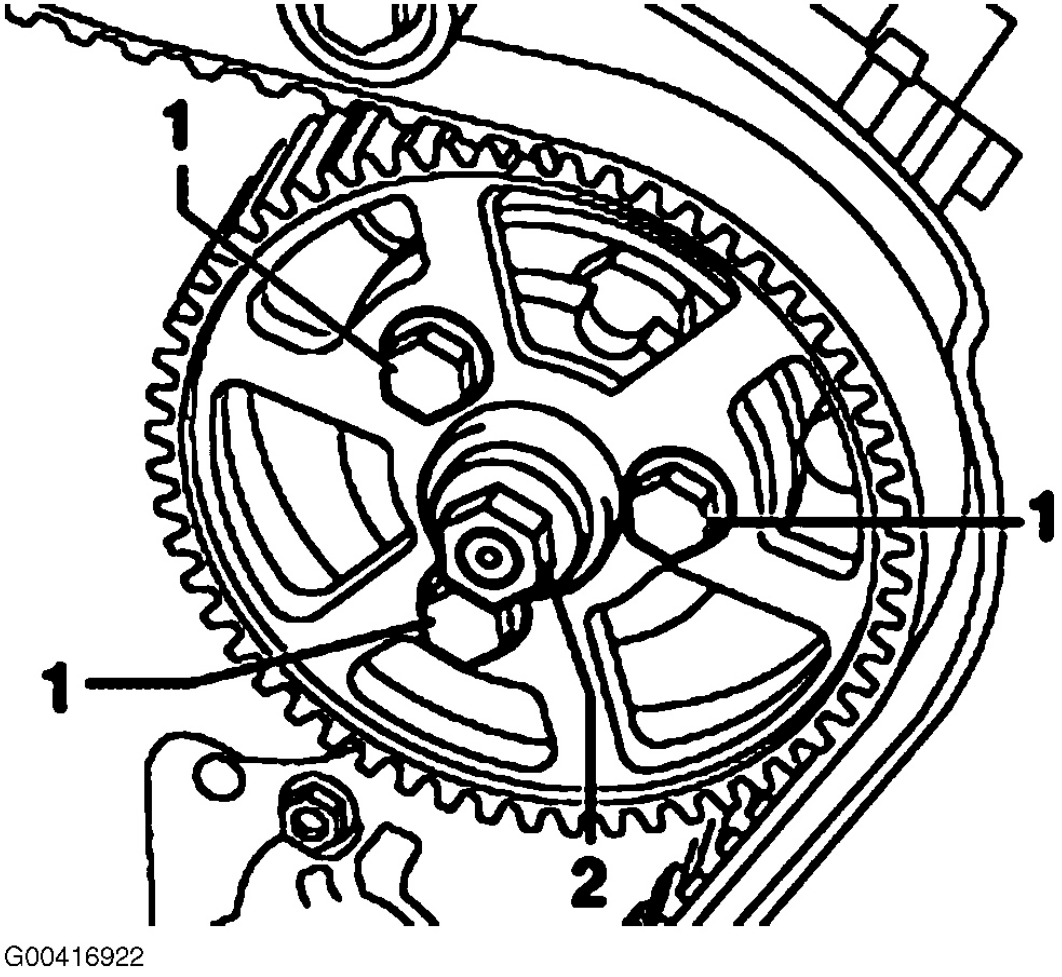

Fig. 98: Bolting Bracket T10014 In Forward Threaded Hole Of Removed Engine Bracket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Use second spindle -A- and supplementary hook 10-222 A/2, lift engine slightly until spindle -B- is not under tension.
- Unhook spindle -B- from lifting eye -1- and slide to side.

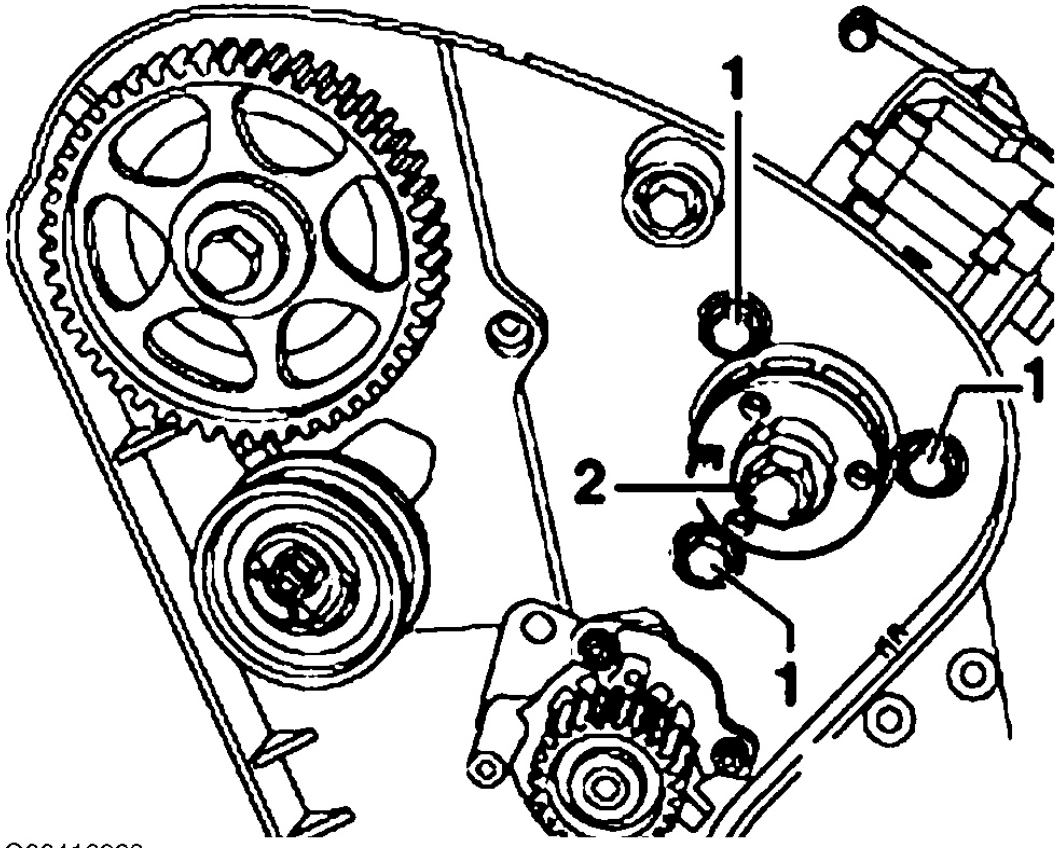

Fig. 99: Unhooking Spindle -B- From Lifting Eye
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove cylinder head cover. See **CYLINDER HEAD COVER, REMOVING AND INSTALLING** .
- Maintain sequence when loosening and tightening cylinder head bolts.
- Lift cylinder head out with the aid of an assistant.

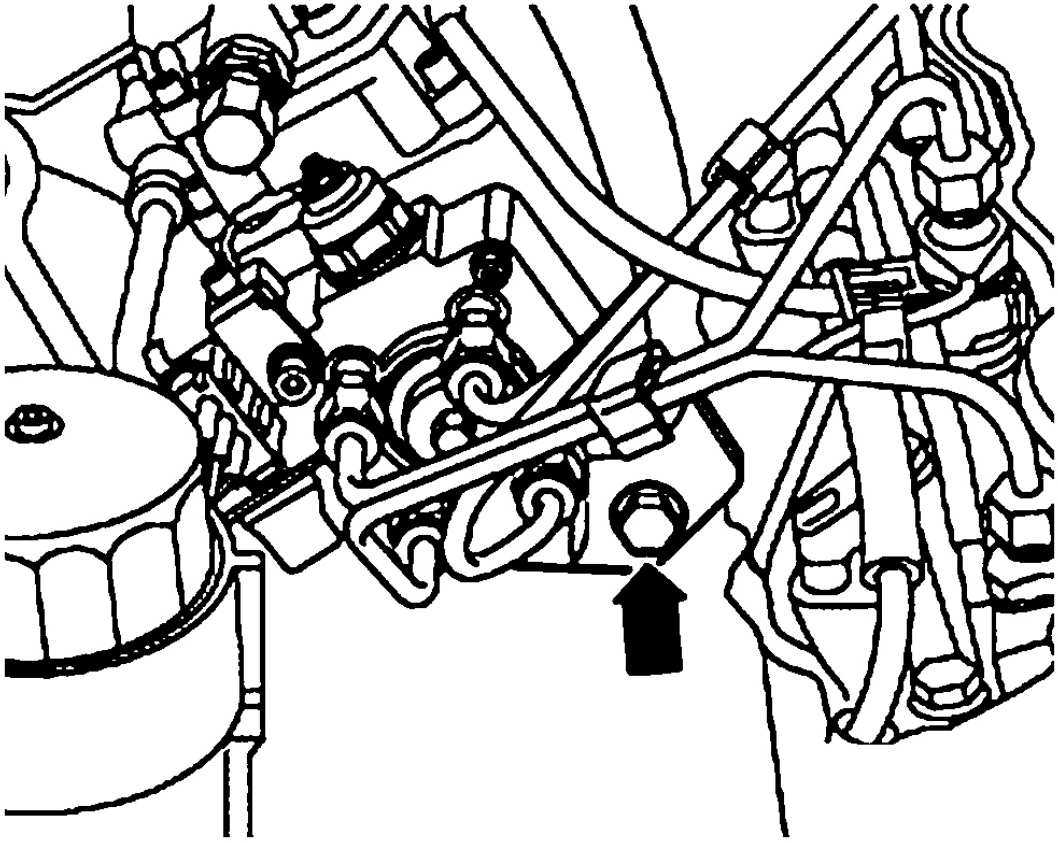

Fig. 100: Identifying Cylinder Head Bolt Loosening Sequence
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE:

- **Always replace cylinder head bolts.**
- **In cases of repair carefully remove gasket remains from cylinder head and cylinder block. Make sure that no long grooves or scratches are created. When using abrasive paper do not use a grade less than 100.**
- **Carefully remove emery and abrasive materials.**
- **Blow forcibly into the threaded holes for the cylinder head bolts. Place a cloth onto the respective hole for protection against oil splashes.**
- **Only unpack new cylinder head gasket and sealant immediately prior to installation.**
- **Handle the new gasket with extreme care. Damages to the silicone film and in the depression area will result in leaks.**

- **Charge pressure hoses and line connections must be free of oil and grease before reinstalling.**

- Turn crankshaft to TDC marking before installing cylinder head.
- Turn crankshaft against engine direction of rotation until all pistons are approximately equally placed below TDC.
- Note cylinder head gasket identification.
  - Part No. = arrow -1-
  - Control code = arrow -2- (not significant!)
  - Hole(s) = arrow -3-

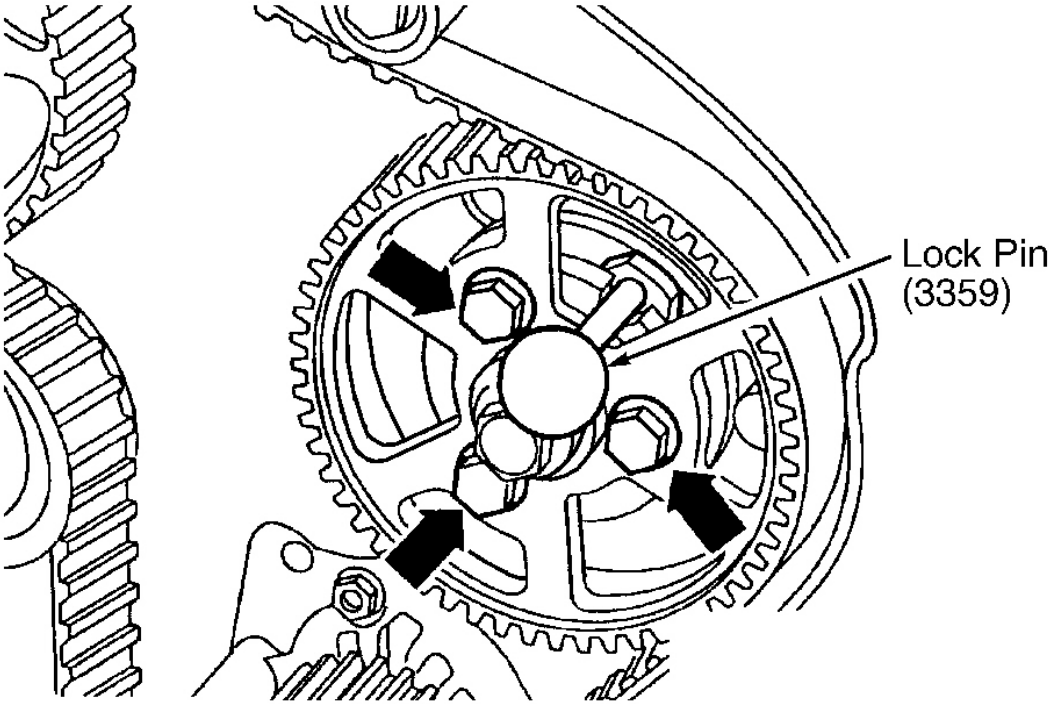

Fig. 101: Identifying Cylinder Head Gasket Control Code And Hole
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **If the cylinder head gasket or the cylinder head are replaced, use a new cylinder head gasket with same number of holes as the old gasket.**

- **If components of the crankshaft system have been replaced the new cylinder head gasket must be re-selected by measuring the piston projection in TDC. See PISTON PROJECTION AT TDC, CHECKING .**

- Install cylinder head sealant.
  - Observe center sleeves (arrows) in cylinder block.

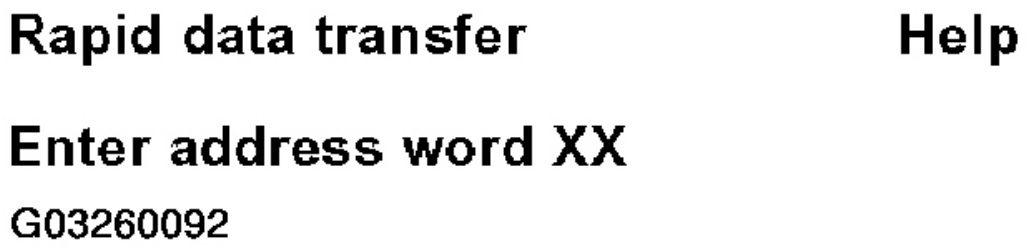

Fig. 102: Locating Center Sleeves In Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

  - Observe head gasket installation position, identification "above" or Part No. must show to cylinder head.
- Install cylinder head and cylinder head bolts, and tighten by hand.
- Tighten cylinder head in four stages in sequence shown as follows:
- Tighten initially with torque wrench:

  Stage I = 40 N.m

  Stage II = 60 N.m

- Turn further with normal spanner:

  Stage III = 1/4 turn (90°)

  Stage IV = 1/4 turn (90°)

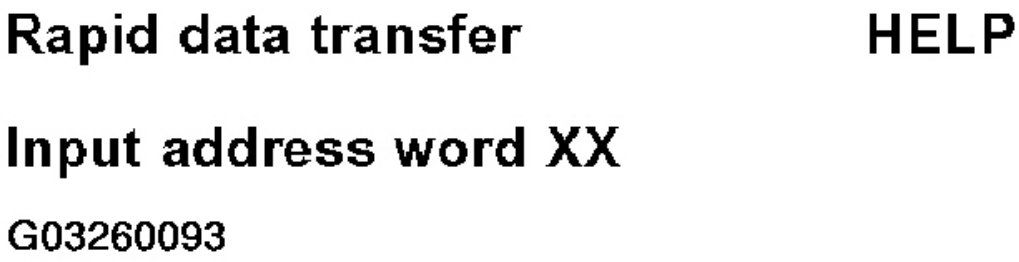

Fig. 103: Cylinder Head Bolt Tightening Sequence
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **It is not necessary to retighten cylinder head bolts after completing the repairs.**

- After tightening cylinder head, turn camshaft hub so cam lobes for cylinder No. 1 point evenly upward (arrows).

Install in reverse order.

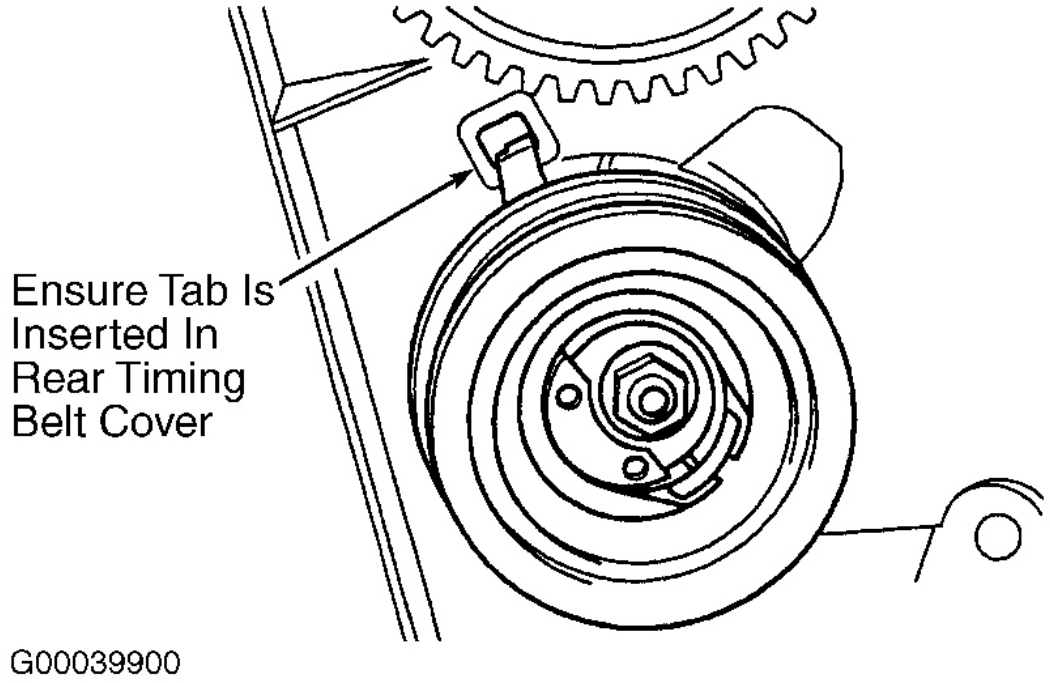

Fig. 104: Cam Lobes For Cylinder No. 1 Pointing Upward
Courtesy of VOLKSWAGEN OF AMERICA, INC.

CAUTION: When performing repair work, especially due to the confined conditions in the engine compartment, pay attention to the following:

- **Route all types of hoses/lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum) as well as electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

- Observe tightening sequence for securing bolts when installing oil return line. See **PART 3: REMOVING AND INSTALLING OIL RETURN LINE TO TURBOCHARGER** .
- Before installing toothed belt, turn crankshaft in direction of engine rotation to TDC and lock in position using crankshaft stop T10050.
- Perform a road test and check DTC memory. See **ENGINE CONTROL MODULE (DTC) MEMORY, READING AND ERASING** .

Compression pressure, checking

Special tools and equipment

- 3220 Jointed wrench
- V.A.G 1331 Torque wrench (5 to 50 N.m)
- V.A.G 1381/12 Adapter
- V.A.G 1763 Compression tester

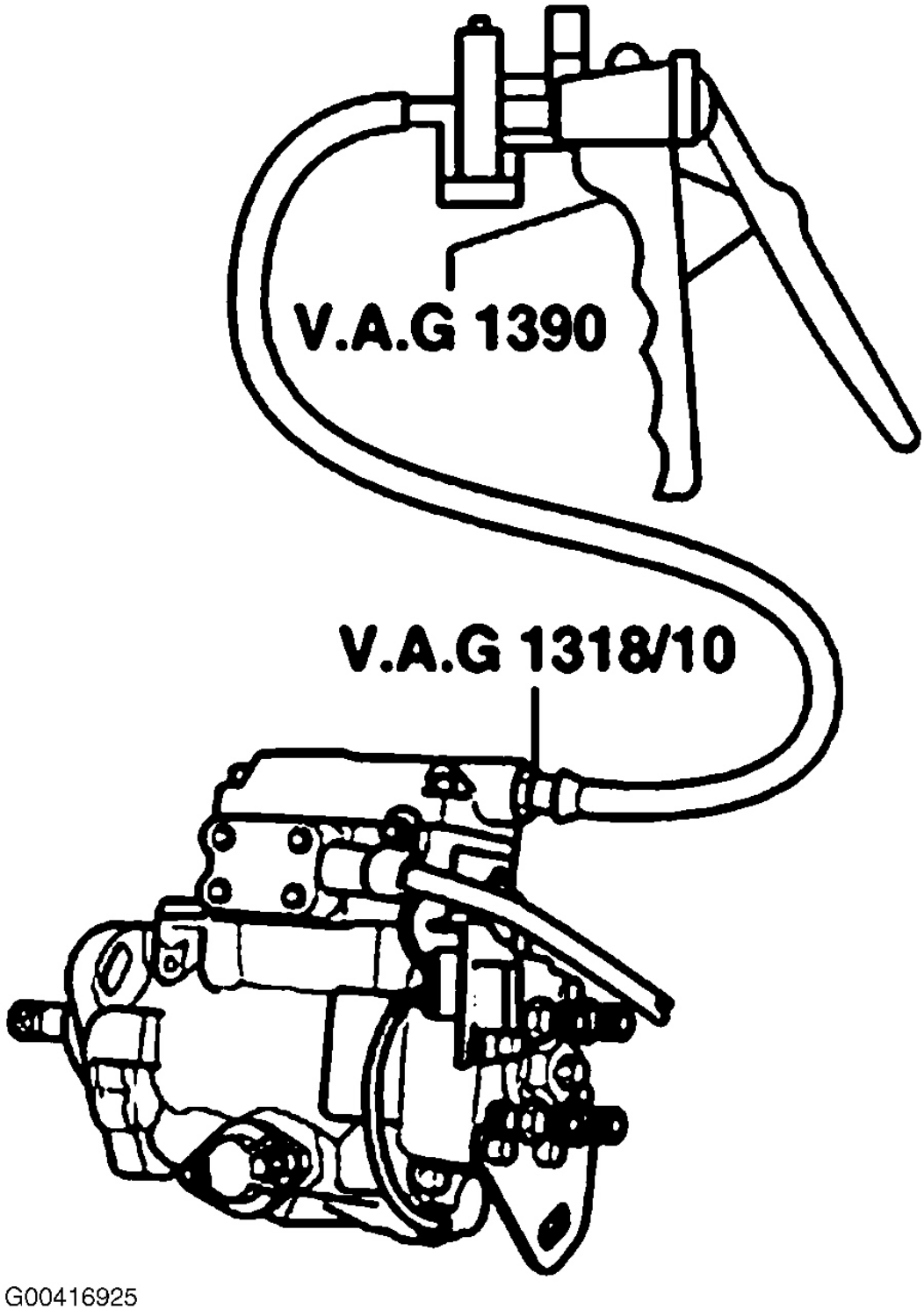

Fig. 105: Identifying Special Tools And Equipment

Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirement

- Engine oil temperature must be min. 30°C

Work sequence

- Remove engine cover.
- Remove central connector for unit injectors -1-.
- Disconnect connector strip -2- from glow plugs.
- Remove all glow plugs -3- using jointed wrench 3220.

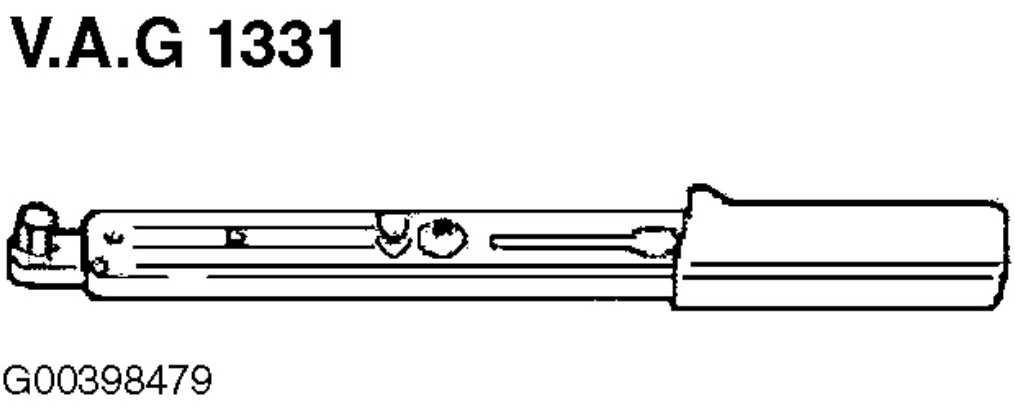

Fig. 106: Removing Unit Injector Central Connector, Connector Strip And Glow Plugs
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Thread in adapter V.A.G 1381/12 in place of glow plugs.

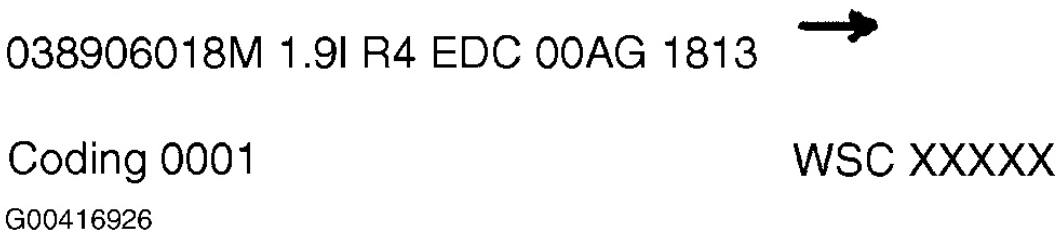

Fig. 107: Checking Compression Pressure
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check compression pressure using compression tester V.A.G 1763.

NOTE: Using the compression tester --> tester operating instructions.

- Operate starter until tester shows no further pressure increase.

Compression pressures

- New: 25 to 31 bar
- Wear limit: 19 bar

Permissible difference between all cylinders: 5 bar

- Install glow plugs with jointed spanner 3220

  Tightening torque: 15 N.m

- Check DTC memory. See **ENGINE CONTROL MODULE (DTC) MEMORY, READING AND ERASING** .

NOTE: Trouble codes will be stored because the diesel injection pump harness connector has been disconnected. Check and erase DTC memory.

VALVE TRAIN, SERVICING

NOTE:

- **Cylinder heads with cracks between the valve seats may be used without reducing engine life, provided the cracks are small and not more than 0.5 mm wide.**
- **Do not rework valve seats. Only lapping-in of valves is permitted.**

Fig. 108: Exploded View Of Valve Train Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

1. **20 N.m plus an additional 1/4 turn (90°)**
   - Always replace
   - Note sequence when loosening and tightening. See **CAMSHAFT, REMOVING AND INSTALLING** .
2. **Rocker shaft**
   - Do not interchange
3. **Cylinder head bolt**
   - Note sequence when loosening and tightening. See **CYLINDER HEAD, REMOVING AND INSTALLING** .
   - Before installing, install washers item 4 into cylinder head
4. **Washer**
   - For cylinder head bolts
   - Install into cylinder head before installing bearing caps
5. **Hydraulic lifters**
   - Do not interchange.
   - With hydraulic valve clearance compensation.
   - Store with cam contact surface downward.
   - Before installing check camshaft axial clearance. See **Checking camshaft axial clearance**
   - Oil contact surfaces.
   - Before removing, remove camshaft bearing shells
6. **Keepers**
7. **Valve spring plate**
8. **Exterior valve spring**
   - Removing and installing: Cylinder head

   Removed: with 2037

   Installed: See **VALVE STEM SEALS, REPLACING** , Replacing valve stem seals

9. **Interior valve spring**
   - Removing and installing: Cylinder head

   Removed: with 2037

   Installed: See **VALVE STEM SEALS, REPLACING** .

10. **Valve stem seal**
    - Replacing. See **VALVE STEM SEALS, REPLACING**
11. **Valve guide**
    - Checking. See **VALVE GUIDES, CHECKING**

- If wear limit is exceeded, replace cylinder head

12. **Unit injector**
    - Removing and installing. See **INJECTOR UNIT, REMOVING AND INSTALLING** .
13. **Cylinder head**
    - See notes under **VALVE TRAIN, SERVICING**
14. **Seal**
    - Do not add oil or grease oil seal sealing lip
    - Remove oil residues of camshaft pin with a clean cloth before installing.
    - Seal groove on camshaft taper when installing with commercially available sticky tape (e.g. Tesafilm)
    - Removing and installing. See **OIL SEAL, REMOVING AND INSTALLING**
15. **Valves**
    - Replace valve when scoring can be seen at shaft and contact surfaces
    - Do not rework. Only lapping-in is permitted
    - Valve dimensions. See **Fig. 111**
16. **Bearing shell**
    - Do not interchange used bearing shells (mark)
    - Make sure tabs seating correctly in bearing cap and cylinder head
17. **Camshaft**
    - Checking axial clearance. See **Checking camshaft axial clearance**
    - Removing and installing. See **CAMSHAFT, REMOVING AND INSTALLING**
    - Check radial clearance with plastigage

      Wear limit: 0.11 mm

    - Run-out: max. 0.04 mm
18. **Bearing cap**
    - Installation sequence. See **CAMSHAFT, REMOVING AND INSTALLING** .
    - Install seal bearing cap contact surfaces 1 and 5 with AMV 174 004 01. See **Sealing bearing cap contact surfaces 1 and 5 with AMV 174 004 01**
19. **8 N.m plus an additional 1/4 turn (90°)**
    - Always replace

Checking camshaft axial clearance

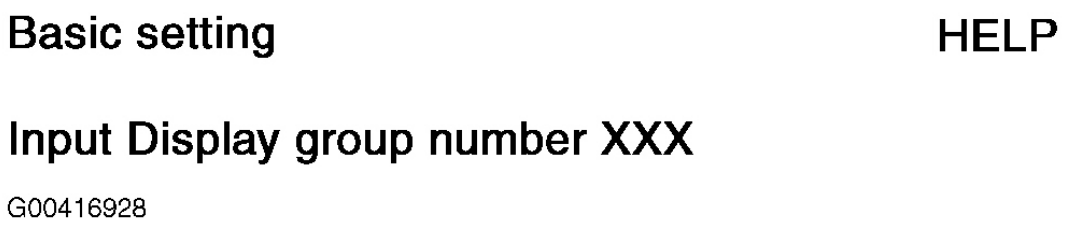

Fig. 109: Checking Camshaft Axial Clearance (End Play)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- VW 387 Universal dial gauge bracket
- Dial gauge

Measure with hydraulic lifters removed and with first, third and last bearing caps installed.

Wear limit: max. 0.15 mm

Sealing bearing cap contact surfaces 1 and 5 with AMV 174 004 01

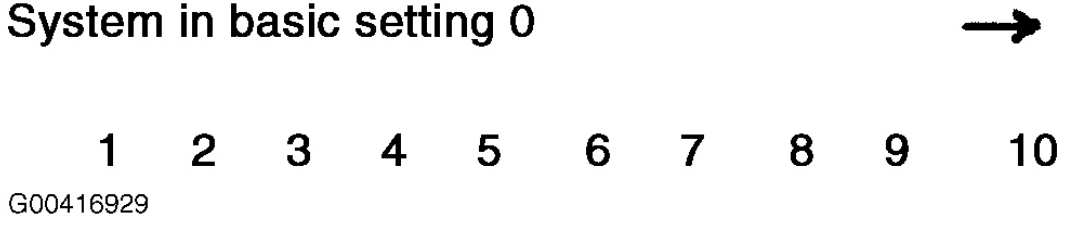

Fig. 110: Sealing Bearing Cap Contact Surfaces
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Apply a thin even coat of sealant AMV 17400401 onto surfaces -1-.

NOTE: Observe that no sealant comes into the grooves (arrows).

Valve dimensions

X DTC recognized!

G03260101

Fig. 111: Identifying Valve Dimensions
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Valves must not be reworked. Only lapping-in is permitted.

VALVE DIMENSIONS

Dimensions	Intake valve	Exhaust valve
diameter a (mm)	35.95	31.45
diameter b (mm)	6.980	6.956
length c (mm)	89.95	89.95
contact face angle	45 degrees	45 degrees

Valve guides, checking

Special tools and equipment

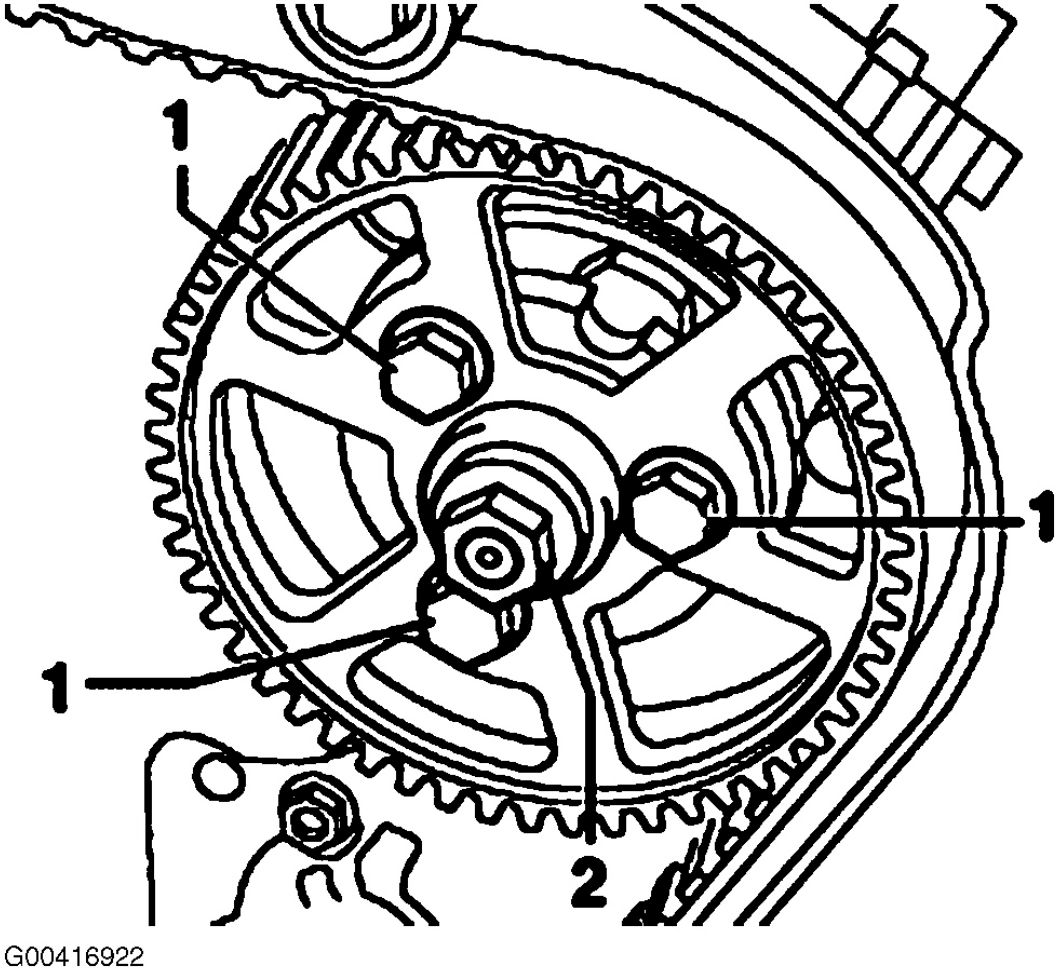

Fig. 112: Identifying Special Tools And Equipment (VW 387)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VW 387 Universal dial gauge bracket
- Dial gauge

Work sequence

- Install old valve into corresponding guide. Due to slight differences in stem dimensions, make sure that an intake valve is used in intake guide and an exhaust valve in exhaust guide. End of valve stem must be flush with guide.

  Valve rock: max. 1.3 mm

Fig. 113: Measuring Valve Rock
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **If the wear limit is exceeded, repeat the calculation with new valves. If the wear limit is still exceeded replace the cylinder head. Valve guides cannot be replaced.**
- **If the valve is to be replaced as part of a repair, use a new valve for the calculation.**

Valve stem seals, replacing

Special tools and equipment

- 2036 Adjustable rod
- 3047A Slide hammer
- 3129 Seal driver
- VW 541/1A Valve spring lever
- VW 541/5 Thrust piece

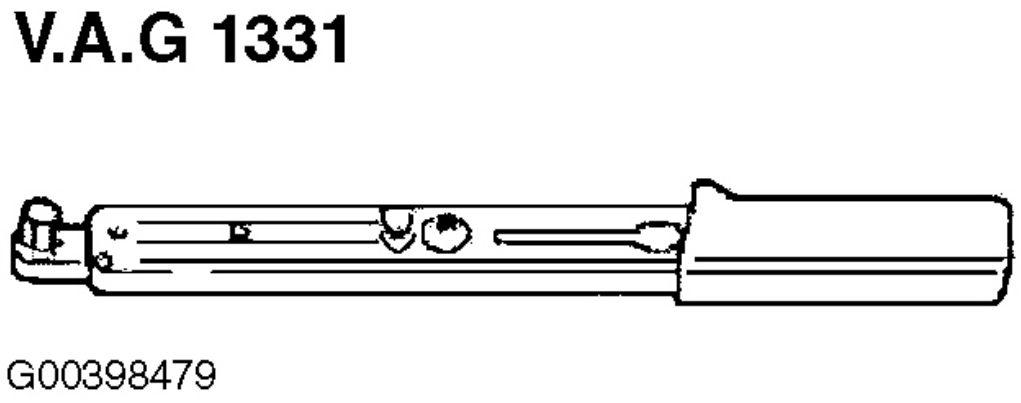

Fig. 114: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

(with cylinder head installed)

- Remove camshaft. See **CAMSHAFT, REMOVING AND INSTALLING** .
- Remove hydraulic lifters and set them with contact surfaces facing down. Make sure lifters are not interchanged during this process.
- Set piston of respective cylinder to top dead center (TDC).
- Install tool 2036 and adjust mountings to height of studs.

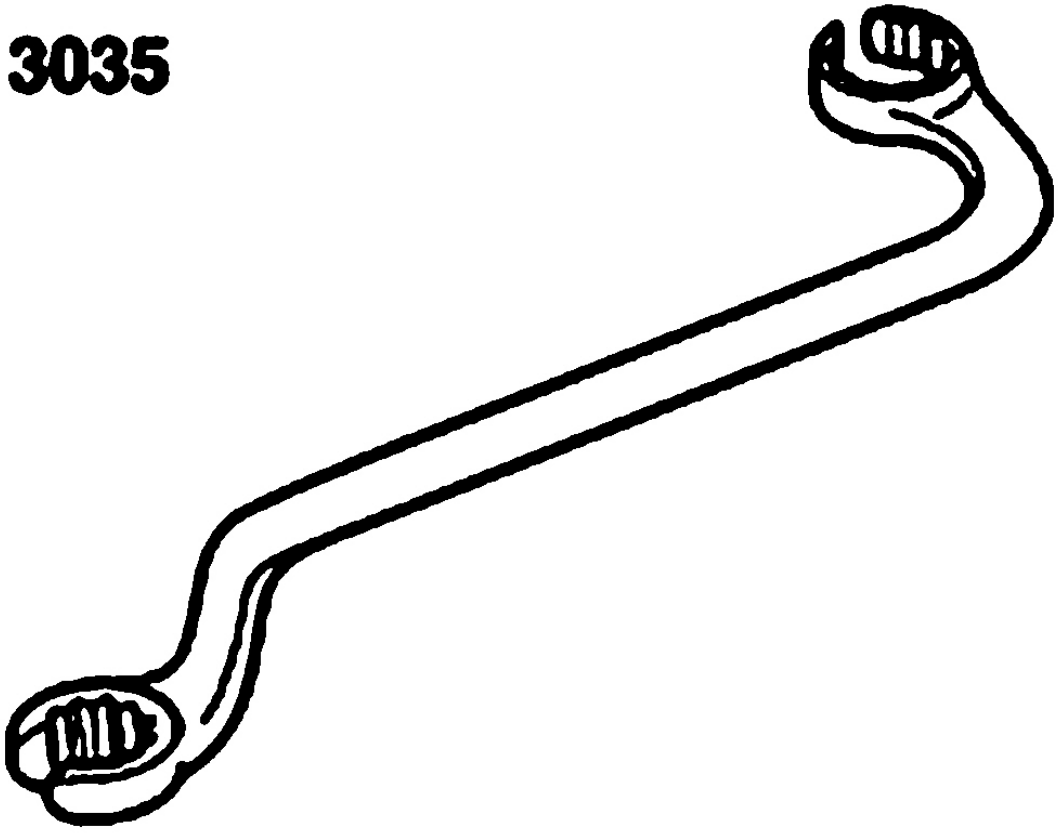

Fig. 115: Installing Tool 2036 And Adjust Mountings To Height Of Studs
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove valve springs with assembly lever VW 541/1A and thrust piece VW 541/5.

NOTE: The valves are supported by the piston crown.

- Remove valve stem seals using 3047A.

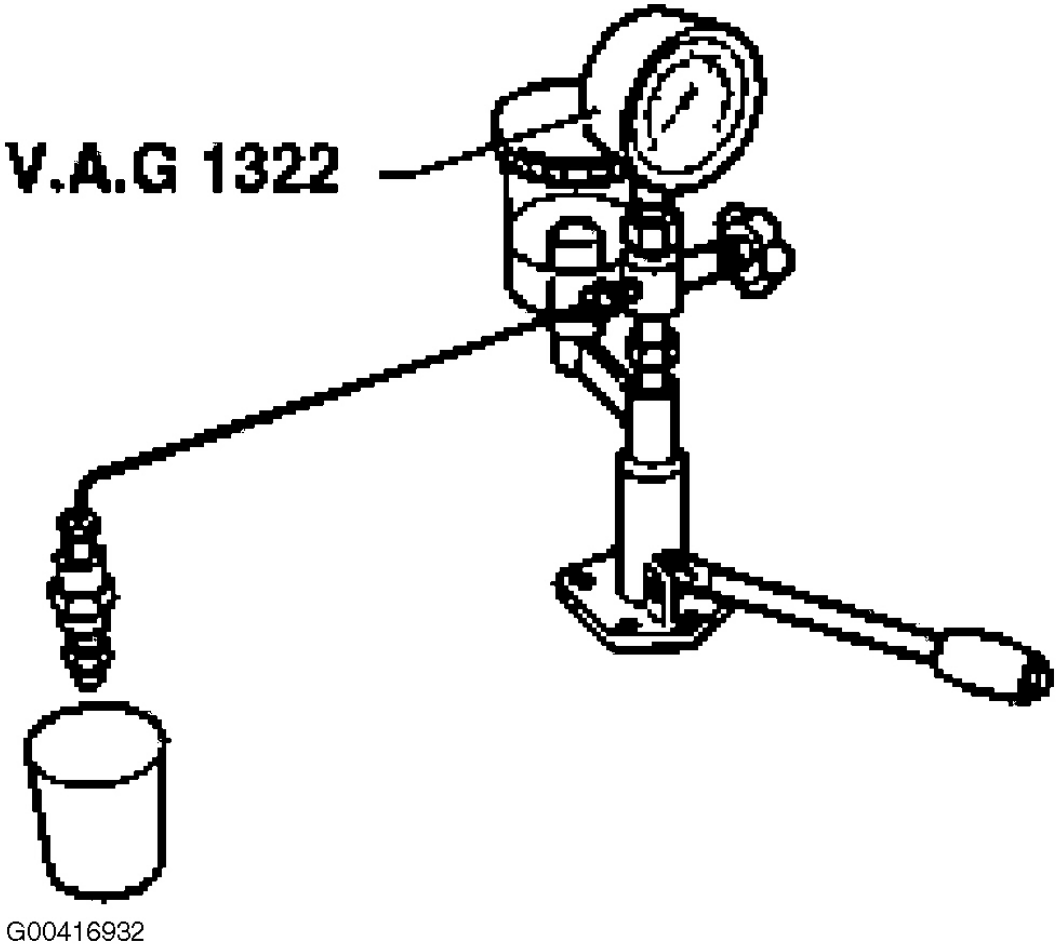

Fig. 116: Removing Valve Stem Seals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

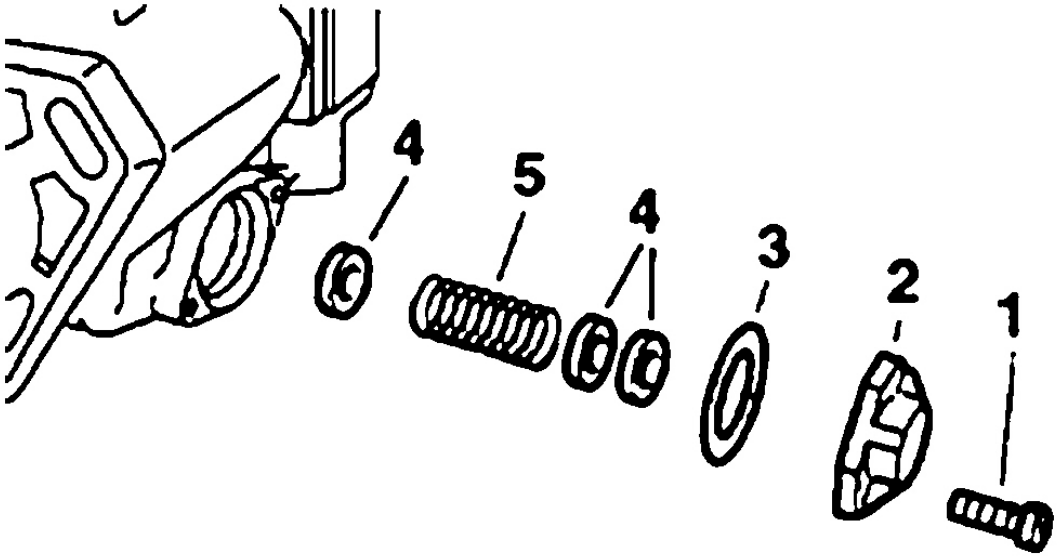

Fig. 117: Inserting Valve Stem Seal Into Installation Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Place plastic sleeve -A- supplied on appropriate valve stem. This will prevent new valve stem seal -B- from being damaged.
- Insert new valve stem seal into installation tool 3129.
- Oil valve stem seal sealing lip and press carefully onto valve guide.

Camshaft, removing and installing

Special tools and equipment

- T10051 Counterhold
- T10052 Puller
- V.A.G1331 Torque wrench (5 to 50 N.m)
- V.A.G 1332 Torque wrench (40 to 200 N.m)
- Sealant AMV 174 004 01

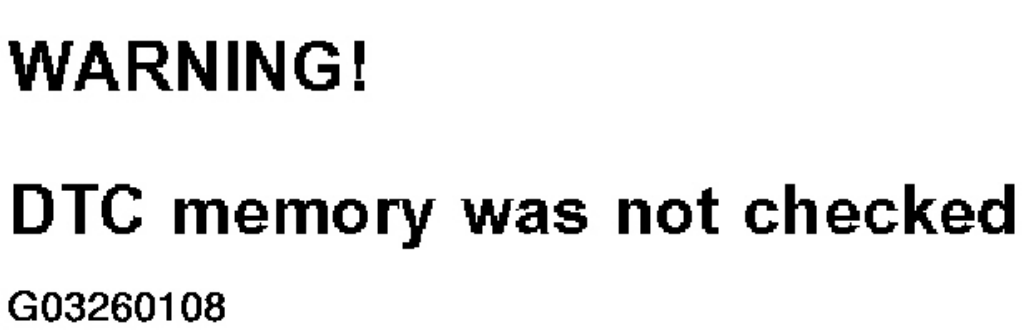

Fig. 118: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove toothed belt. See **TOOTHED BELT, REMOVING AND INSTALLING** .
- Remove camshaft gear securing bolts -1-.

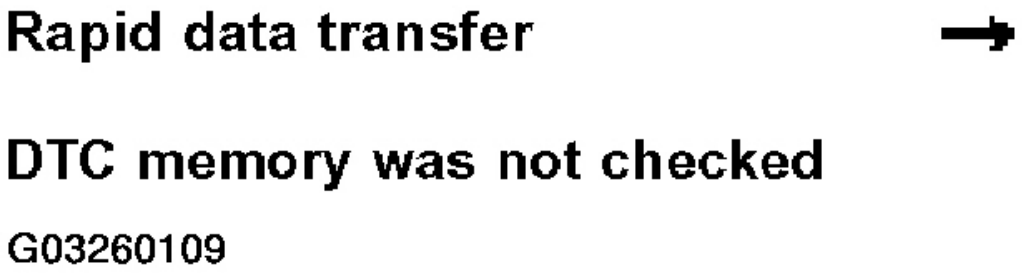

Fig. 119: Removing Camshaft Gear Securing Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove camshaft gear from hub.
- Using counterhold T10051, loosen camshaft pulley securing bolt -1- from hub.

Fig. 120: Loosening Camshaft Pulley Securing Bolt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unscrew hub securing bolt approx. 2 turns.
- Position puller T10052 and thread bolts -1- into hub.
- Pull hub off by counter-holding puller with a wrench (30 mm) and turning bolt -2-.

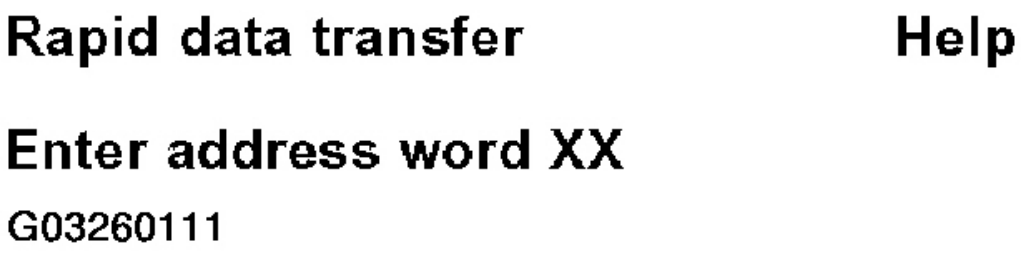

Fig. 121: Removing Hub Using Puller T10052
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove cylinder head cover. See **CYLINDER HEAD COVER, REMOVING AND INSTALLING** .
- Mark rocker shafts with a waterproof felt-tipped pen to avoid interchanging and therefore disrupting injection pump basic setting (arrows).
- Loosen exterior bolts -1- at rocker shaft first and then interior bolts -2-.

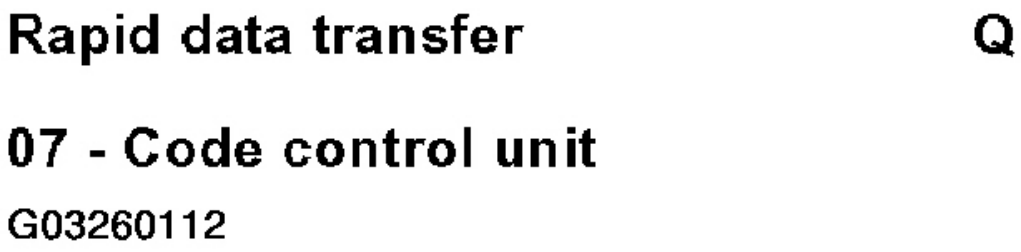

Fig. 122: Loosening Rocker Shaft Exterior Bolts And Interior Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove rocker shafts.
- Remove tandem pump. See **TANDEM PUMP, REMOVING AND INSTALLING** .
- First remove bearing caps 5, 1 and 3. Loosen bearing caps 2 and 4 alternately and diagonally.

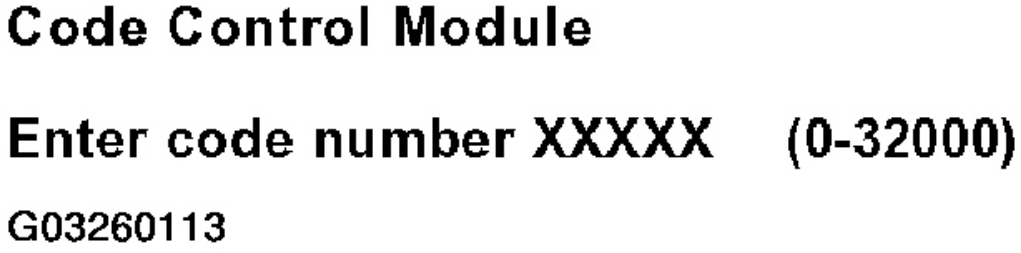

Fig. 123: Removing Camshaft Bearing Caps
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:
- **Make sure that the camshaft bearing shells are not interchanged.**
- **Mark the allocation of the camshaft bearing shells on the back with a waterproof felt-tipped pen.**

- Remove camshaft.

Installing

NOTE:

- **When installing the camshaft No. 1 cylinder cam lobes must point upward.**

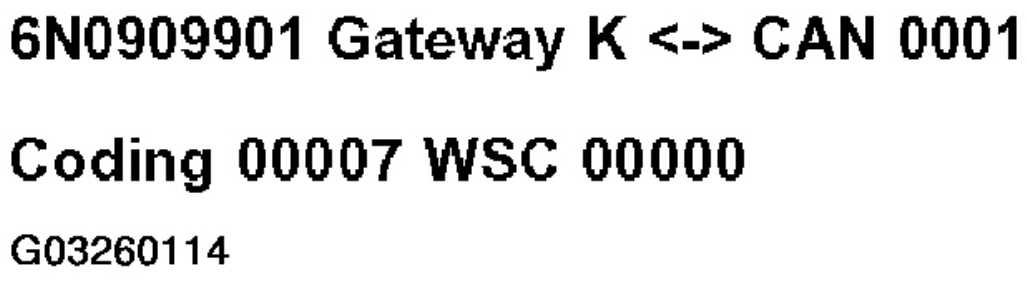

Fig. 124: Identifying No. 1 Cylinder Cam Lobes
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- **Do not interchange used bearing shells (observe marking).**
- **Observe correct seat of the bearing shell tabs in the bearing caps and the cylinder head when installing the camshaft.**
- **Before installing the bearing caps observe that the washers for the cylinder head bolts are installed in the cylinder head.**

- Oil contact surfaces of bearing shells.
- Install bearing shell 2 and 4 and tighten new bolts alternately and diagonally to:

  8 N.m plus an additional 1/4 turn (90°).

- Install bearing caps 5, 1 and 3 and also tighten new screws to:

  8 N.m plus an additional 1/4 turn (90°).

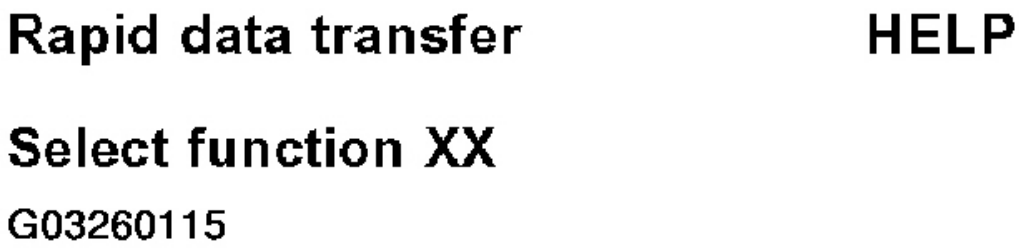

Fig. 125: Identifying Camshaft Bearing Caps
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **Seal bearing caps 1 and 5 contact surfaces with AMV 174 004 01. See SPECIAL TOOLS AND EQUIPMENT . See Fig. 110 .**
- **Bearing cap 5 -1- must fit flush with outer edge of the cylinder head -2- (arrows), otherwise this may lead to tandem pump leakage.**

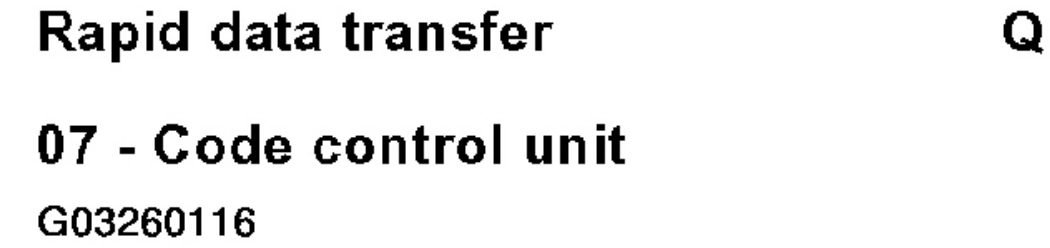

Fig. 126: Bearing Cap 5 Must Fit Flush With Outer Edge Of The Cylinder Head
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install camshaft seal. See **OIL SEAL, REMOVING AND INSTALLING** .
- Install rocker shaft and tighten interior new securing bolts -2- first and then exterior bolts -1- using alternate and diagonal sequence evenly.

  Tightening torque: 20 N.m plus an additional 1/4 turn (90°)

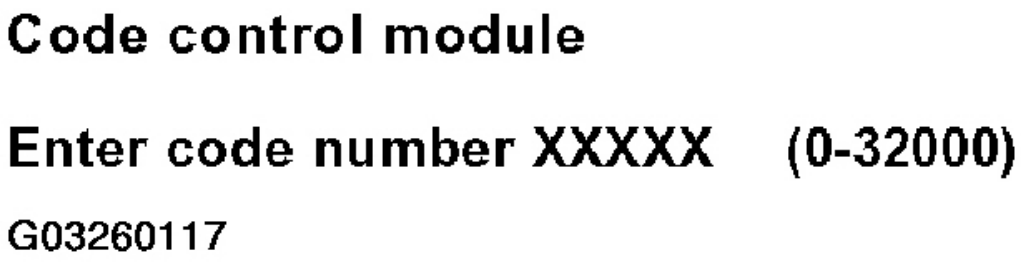

Fig. 127: Tightening Rocker Shaft Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install hub onto camshaft.
- Using counterhold T10051 tighten camshaft pulley securing bolt -1- to hub.

  Tightening torque: 100 N.m

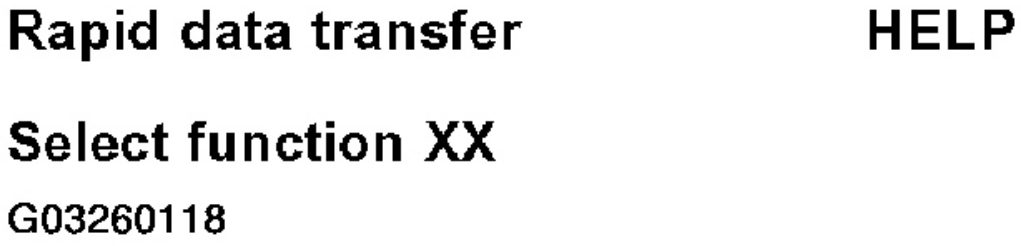

Fig. 128: Tightening Camshaft Pulley Securing Bolt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install camshaft gear on hub.

NOTE: The tooth segment (arrow) of the camshaft gear must point upward.

Rapid data transfer Q

08 - Read Measuring Value Block

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Fig. 129: Tooth Segment (Arrow) Of The Camshaft Gear Must Point Upward
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Align camshaft pulley to center position in elongated holes.
- Tighten camshaft pulley securing bolts -1- by hand until there is no play.
- Lock hub with pin 3359.
- Install toothed belt. See **TOOTHED BELT, REMOVING AND INSTALLING** .
- Install cylinder head. See **CYLINDER HEAD COVER, REMOVING AND INSTALLING** .
- Install tandem pump. See **TANDEM PUMP, REMOVING AND INSTALLING** .

NOTE:

- **When new lifters have been installed the engine must not be started for about 30 minutes. Hydraulic compensation elements must settle (otherwise valves will strike pistons).**
- **Turn engine at least two revolutions after valve gear repairs to assure that no valve will make contact when starting.**

- If rocker shafts or ball pins and adjustment screws were replaced, unit injectors must be adjusted. See **INJECTOR UNIT, REMOVING AND INSTALLING** .

Oil seal, removing and installing

Special tools and equipment

- 10-203 Puller
- 3240 Oil seal extractor
- V.A.G 1331 Torque wrench (5 to 50 N.m)
- V.A.G 1332 Torque wrench (40 to 200 N.m)
- Screw M12 x 1.5 x 65

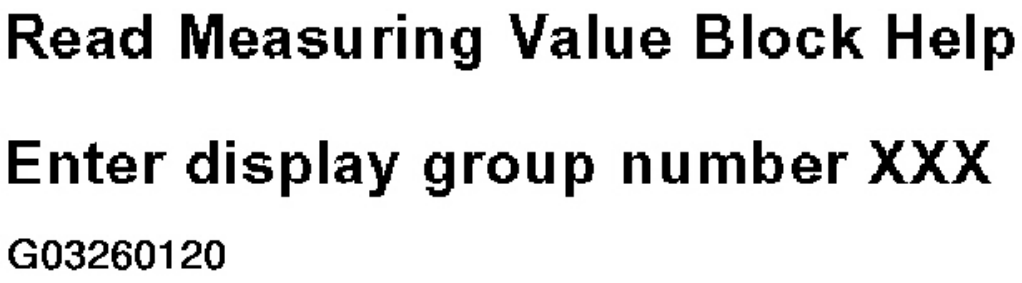


Fig. 130: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove toothed (timing) belt. See **TOOTHED BELT, REMOVING AND INSTALLING** .
- Remove camshaft gear and hub. See **CAMSHAFT, REMOVING AND INSTALLING** .
- Unscrew inner part of oil seal extractor 3240 two turns (approx. 3 mm) out of outer part and lock in position with knurled screw.
- Lubricate oil seal extractor threaded head, place it in position and exerting firm pressure screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part against camshaft until oil seal is pulled out.

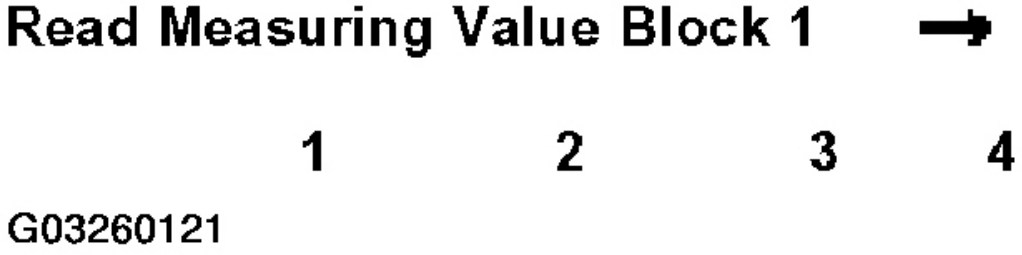


Fig. 131: Removing Camshaft Oil Seal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE: Do not oil or grease the oil seal sealing lip.

- Before installing, remove oil remains from camshaft journal with a clean cloth.
- Tape off groove in camshaft taper with commercially available sticky tape (e.g. Tesafilm).
- Place oil seal carefully on camshaft.
- Press in seal with pressure piece of pulling device 10-203 and turn M12 x 1.5 x 65 bolt onto limit stop.
- Install toothed belt. See **TOOTHED BELT, REMOVING AND INSTALLING** .

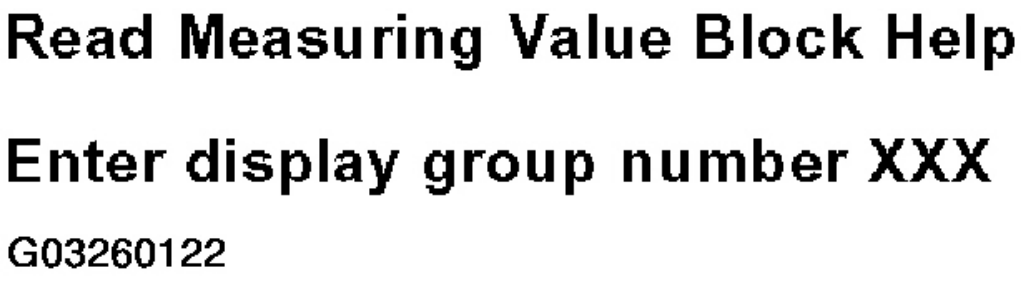


Fig. 132: Installing Camshaft Oil Seal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

ENGINE - LUBRICATION

LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING

NOTE:

- **If large quantities of metal particles or other deposits (caused, for example, by partial seizure of the crankshaft or connecting rod bearings) are found in the engine oil when performing repairs, clean the oil passages thoroughly and replace the oil cooler (mandatory) to prevent future damage.**
- **The oil level must not be above the max. mark or there is the possibility of damage to the catalytic converter! Markings. See , Fig. 134**

Checking oil pressure. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING** .

Oil system capacity

- with oil filter: 4.5 liters

Engine oil specifications

Only use engine oil conforming to VW standard 505 01.

Part 1

Part 2, Disassembling oil filter bracket. See **PART 2: DISASSEMBLING OIL FILTER BRACKET** .

Part 3, Removing and installing oil return line to turbocharger. See **PART 3: REMOVING AND INSTALLING OIL RETURN LINE TO TURBOCHARGER** .

NOTE: The following list refers to items in Fig. 133 .

1. **15 N.m**
2. **Sealing flange**
   - With sealing ring
   - Must be located on dowel sleeves.
   - Removing and installing. See **SEALING FLANGE - BELT PULLEY END, REMOVING AND INSTALLING** .
   - Insert with silicone sealant D 176 404 A2. See **SEALING FLANGE - BELT PULLEY END, REMOVING AND INSTALLING** .
   - Do not add oil or grease to oil seal sealing lip
   - Before installing, remove oil residue from crankshaft journal using a clean cloth
   - Replacing crankshaft oil seal, poly V-belt pulley end. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING**
3. **Chain tensioner with tensioning rail, 15 N.m**
   - When installing, pretension spring and install
4. **Dipstick**
   - Oil level must not exceed max. mark!
   - Markings. See **Fig. 134**
5. **Guide**
   - Pull off to extract oil
   - With rubber grommet for engine cover
6. **Guide tube**
7. **Oil spray jet**
   - For piston cooling
8. **25 N.m**
   - Insert without sealant
9. **Dowel sleeves**
10. **15 N.m**
11. **Suction line**
    - Clean strainer if soiled

12. **O-ring**
    - Always replace
13. **Baffle plate**
14. **15 N.m**
15. **15 N.m**
16. **Oil pan**
    - Clean sealing surface before installing
    - Insert with silicone sealant D 176 404 A2. See **OIL PAN, REMOVING AND INSTALLING** .
17. **Seal**
    - Always replace
18. **Oil drain plug, 30 N.m**
    - Replace plug with attached seal
19. **19-Oil pump**
    - With pressure relief valve of 12 bar
    - Before installing, check that both dowel sleeves for centering oil pump/cylinder block are installed
    - Replace if contact surfaces and gears are scored
    - Removing and installing. See **OIL PUMP, REMOVING AND INSTALLING**
20. **Chain gear for oil pump**
21. **25 N.m**
    - Use counter-bracket T10051 to loosen and tighten
22. **Chain**
    - Mark direction of rotation before removing

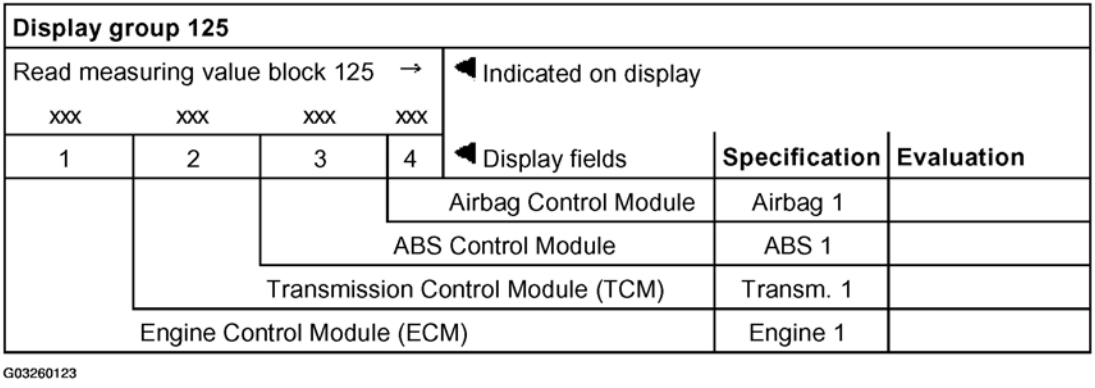


Fig. 133: Identifying Lubrication System Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Dipstick Marks

NOTE: The following lists refers to items in Fig. 134 .

1. max. mark
2. min. mark

a. Area above hatched field up to max. mark: Do not top up with engine oil!
b. Oil level within hatched field: Engine oil level can be topped up.
c. Area from min. mark up to hatched field: Add a max. of 0.5 liter of engine oil!

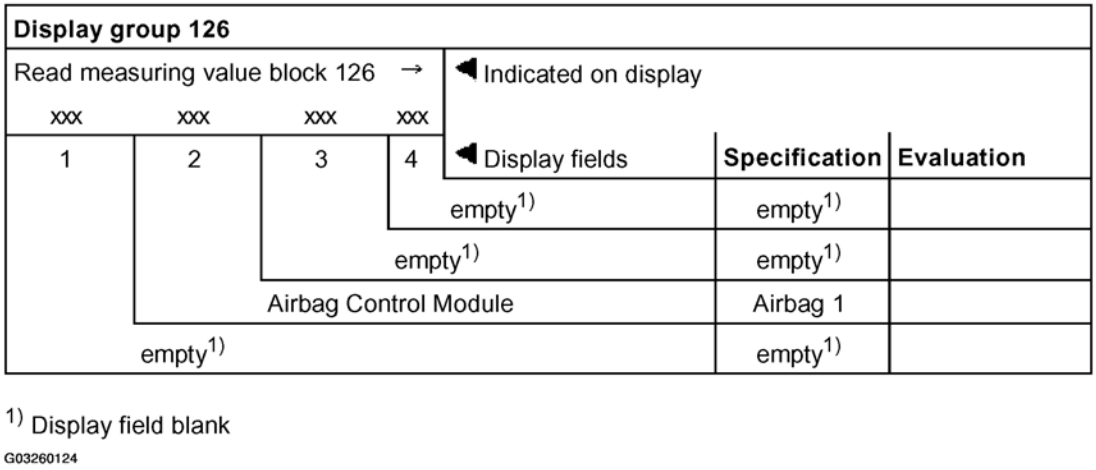


Fig. 134: Identifying Dipstick Marks
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part 2: Disassembling oil filter bracket

NOTE: The following list refers to items in Fig. 135 .

1. **Oil pressure switch -F1-, 20 N.m**
   - 0.7 bar connector, brown
   - If sealing ring is leaking, cut open and replace
   - Checking. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING**
2. **Seal**
   - Always replace
3. **15 N.m plus an additional 1/4 turn (90°)**
   - Always replace
   - First install upper left and lower right bolt, then tighten four bolts diagonally
4. **Oil filter bracket**
5. **Seal**

- Always replace

6. **Oil supply line**
   - To exhaust turbocharger
   - Removing and installing. See **PART 3: REMOVING AND INSTALLING OIL RETURN LINE TO TURBOCHARGER**
7. **Banjo bolt, 20 N.m**
   - Prescribed torque. See item 4 in **PART 3: REMOVING AND INSTALLING OIL RETURN LINE TO TURBOCHARGER** .
8. **Sealing cap, 25 N.m**
   - Loosen and tighten with oil filter wrench 3417
9. **O-ring**
   - Always replace
10. **Oil filter element**
    - Note installed position: top
11. **Sealing plug, 25 N.m**
12. **Seal**
    - Always replace
13. **Oil cooler**
    - Make sure clearance to adjacent components.
    - See note. See **LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING**
14. **Seal**
    - Always replace
    - Install into groove on oil cooler.
15. **Sealing plug, 10 N.m**
    - If sealing ring is leaking, cut open and replace
16. **Sealing plug**
    - For pressure relieve valve
    - Do not loosen

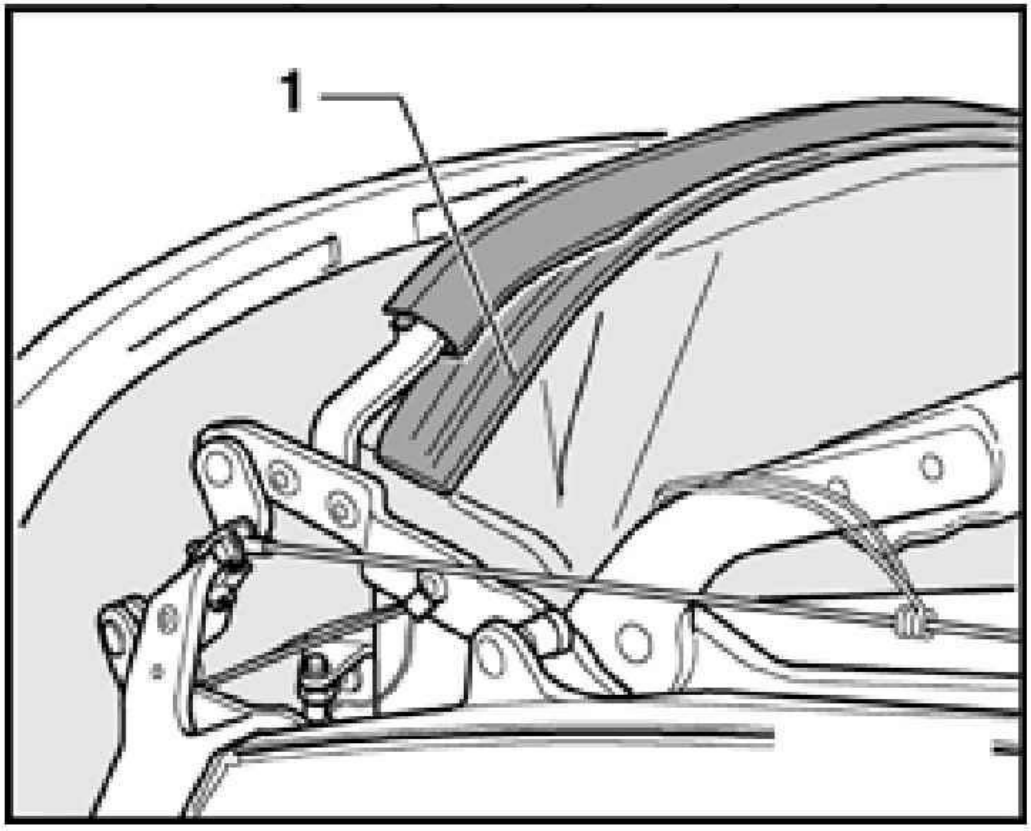


Fig. 135: Disassembling Oil Filter Bracket Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part 3: Removing and installing oil return line to turbocharger

Assembly overview

NOTE: The following list refers to items in Fig. 136 .

1. **Oil supply line**
   - To exhaust turbocharger
2. **Union nut, 22 N.m**
   - When tightening and loosening counterhold line union
3. **Seal**
   - Always replace

4. **Banjo bolt, 25 N.m**
5. **Clamp**
6. **10 N.m**
7. **Bracket**
8. **25 N.m**
    - Always replace
9. **10 N.m**
10. **10 N.m**

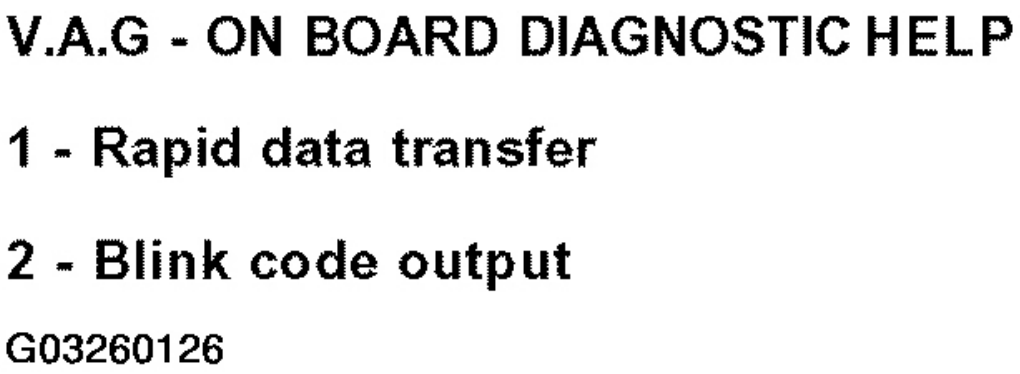


Fig. 136: Turbocharger Oil Lines
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Work sequence

Removing

NOTE: The following list refers to items in Fig. 137 .

- Remove sound insulation.
- Position drip tray V.A.G 1306 underneath.
- Remove air filter housing.
- Unscrew union nut -2- or banjo bolt -4- at oil filter bracket.
- Remove bolt -6-.
- Unfasten union nut -2- at turbocharger.
- Remove bolt -9- from bracket -7-.
- Remove nut -8- and remove bracket -7-.

- Remove oil return line -1-.

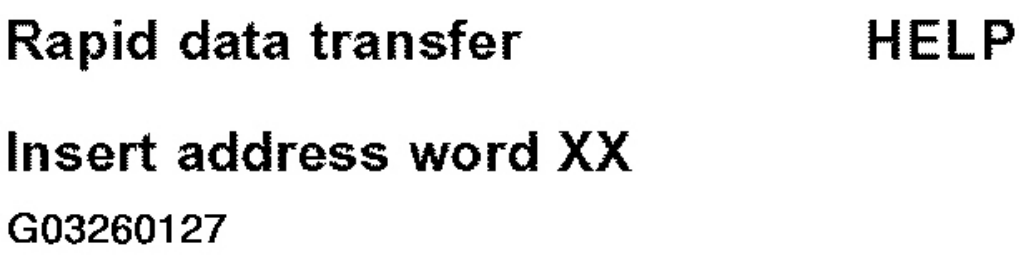


Fig. 137: Turbocharger Oil Lines
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

Installation is performed in reverse sequence of removal. In the process, note the following:

CAUTION: Adhere strictly to the installation procedure for the oil return line.

NOTE: The following list refers to items in Fig. 138 .

- Install bracket -7- with nut -8- loosely to exhaust manifold.
- Install union nut -2- or banjo bolt -4- at oil filter bracket hand-tight.
- Install union nut -2- hand-tight at turbocharger.
- Install union nut -2- or banjo bolt -4- at oil filter bracket with correct tightening torque.
- Install union nut -2- to turbocharger with correct tightening torque.
- Position clamps -5- on oil return line.
- Install bolts -6- and -9- with correct tightening torque.
- Tighten nut -8- with correct tightening torque.

Fig. 138: Turbocharger Oil Lines
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Oil pan, removing and installing

Special tools and equipment

- 3185 Jointed wrench
- T10058 Socket insert
- V.A.G1331 Torque wrench (5 to 50 N.m)
- Hand drill with plastic brush attachment
- Silicone sealing compound D 176 404 A2

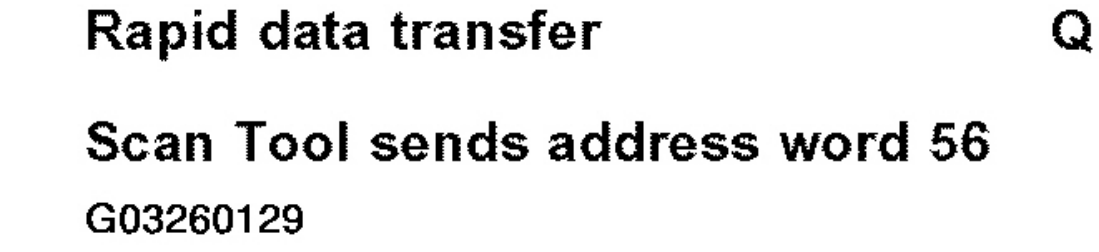


Fig. 139: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove center and right side sound insulation:

See **NOISE INSULATION, ASSEMBLY OVERVIEW** .

- Drain engine oil.

NOTE: Observe disposal regulations!

- Unbolt oil pan.

NOTE: Loosen bolts on flywheel end of oil pan with jointed wrench 3185 and remove with socket T10058.

- Remove oil pan. Loosen oil pan with light blows from a rubber-headed hammer, if necessary.
- Use a flat scraper to remove sealant residue on cylinder block.
- Remove sealant residue from oil pan with a rotating brush, e.g. a hand drill with a plastic brush attachment (wear protective goggles).

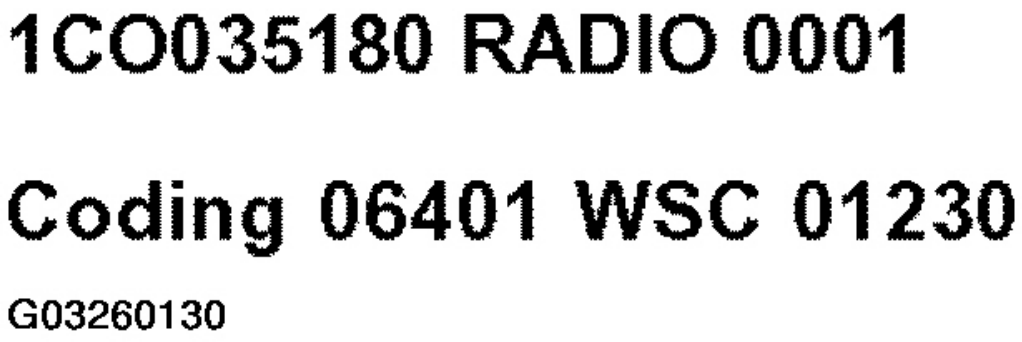


Fig. 140: Removing Sealant Residue From Oil Pan With Rotating Brush
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Clean sealing surfaces. They must be free of oil and grease.

Installing

NOTE:
- **Observe the use-by date of the sealing compound.**
- **The oil pan must be installed within 5 minutes of applying silicone sealing compound.**

- Cut off tube nozzle at front marking (nozzle approx. 3 mm diameter).
- Apply silicone sealing compound, as shown, to clean oil pan sealing surface. Sealant bead must be:

- 2 to 3 mm thick.
- Run bead along inner side of bolt holes (arrows).

Fig. 141: Applying Silicone Sealing Compound To Clean Oil Pan Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The sealing compound bead must not be too thick, otherwise excessive sealing compound will enter the oil pan and may block the oil suction pipe strainer.

- Apply sealing compound bead carefully to areas marked by arrows.

Fig. 142: Apply Sealing Compound Bead Carefully To Areas Marked By Arrows
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install oil pan immediately and tighten all oil pan bolts as follows:

1. Tighten all oil pan/cylinder block bolts lightly using diagonal sequence.

2. Tighten three oil pan/transmission bolts lightly.
3. Tighten all oil pan/cylinder block bolts lightly using diagonal sequence again.
4. Tighten all oil pan/cylinder block bolts to 15 N.m using diagonal sequence.
5. Tighten three oil pan/transmission bolts to 45 N.m.

NOTE:

- **When installing the oil pan with the engine out of the vehicle, make sure that the oil pan is flush with the cylinder block at the flywheel end.**
- **Let sealing compound dry for approx. 30 minutes after installing oil sump. Only then fill engine with oil.**

Further assembly is reverse of the disassembling procedure.

Oil pump, removing and installing

Removing

- Remove oil pan and baffle plate. See **OIL PAN, REMOVING AND INSTALLING** .
- Remove bolt -2-.
- Remove chain gear from oil pump shaft.
- Remove bolts -1- and -3- and remove oil pump.

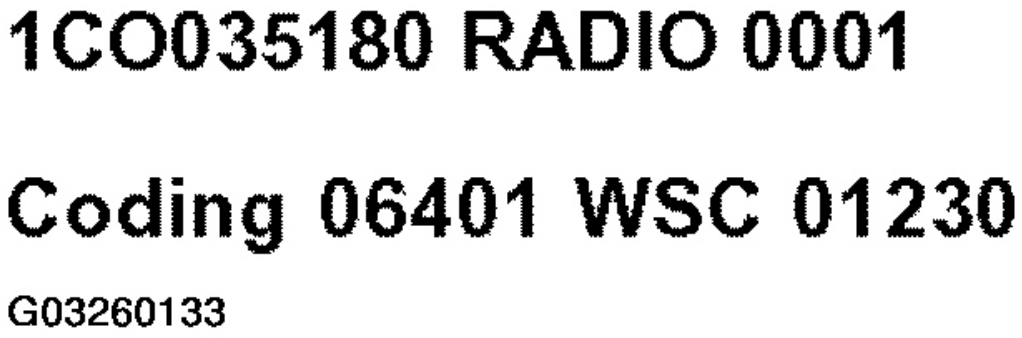


Fig. 143: Removing Bolts -1- And -3- And Oil Pump
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

Installation is performed in reverse sequence of removal. Note the following:

- Dowel sleeves. See **Fig. 133** , position 9 above oil pump.
- Installed position of oil pump shaft/chain gear: installation possible in only one position.
- Install oil pan and baffle plate. See **OIL PAN, REMOVING AND INSTALLING** .

Tightening torques. See PART 1

Oil pressure and oil pressure switch, checking

Special tools and equipment

- V.A.G 1342 Oil pressure tester
- V.A.G 1527 B Diode test lamp
- V.A.G 1594 A Adapter set

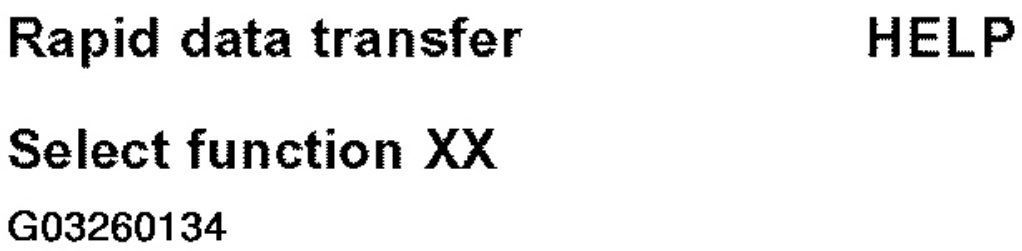


Fig. 144: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Function of dynamic oil pressure warning system

The oil pressure switch is open at no pressure and closes when switch pressure is reached.

The oil pressure is activated approx. 10 seconds after switching ignition on ("terminal 15 on").

Switch-on delay of oil pressure warning: Approx. 3 seconds

Switch off delay for oil pressure warning: Approx. 5 seconds

Checking warning lamp

After switching on ignition when engine is not running, oil pressure warning lamp in instrument cluster must light up for approx. 3 seconds and go out again afterward. The test will be terminated if engine is running.

Criteria for warning

Switching on of optical oil pressure warning (oil pressure warning lamp flashes) and the buzzer sounding three times for acoustical warning will occur under one of the following conditions:

- "Ignition on", engine at rest, oil pressure switch closed
- Engine speed higher than 1500 rpm, oil pressure switch open
- At engine revolutions greater than 5000 rpm the oil pressure warning will not be triggered, even when the oil pressure switch is closed.
- If the oil pressure switch is open (engine revs greater than 1500 rpm) for 0.5 to 3 seconds, this is stored in the combi-processor of instrument cluster. If this condition happens three times while the engine is running, the oil pressure warning is immediately triggered and remains on, even below 1500 rpm. Oil pressure warning goes out when oil pressure switch is closed for longer than 5 seconds when engine revolutions are greater than 1500 rpm or ignition is "switched off".

Requirements

- Engine oil level OK, checking. See , **Fig. 134** .
- Oil pressure warning light -K3- must light up for approx. 3 seconds when ignition is switched on.
- Engine oil temperature at least 80°C (coolant fan must have run once).

Work sequence

- Remove Oil pressure switch -F1- and install in tester.

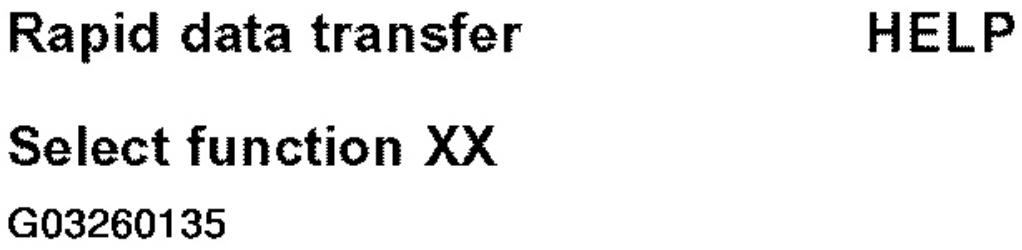


Fig. 145: VAG 1432 Pressure Tester
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Thread tester into oil filter bracket in place of oil pressure switch.
- Connect brown tester wire to Ground (GND).
- Connect diode test lamp V.A.G 1527 B using aux. cables from V.A.G 1594 A to battery positive (+) and oil pressure switch.

LED must not light up

If LED lights up:

- Replace 0.7 bar Oil pressure switch -F1-.

If LED does not light up:

- Start engine and increase speed slowly. At 0.55 to 0.85 bar pressure:

  LED must light up

If LED does not light up:

- Replace oil pressure switch.
- Increase engine speed further.

  At 2000 rpm and an oil temperature of 80°C oil pressure should be at least 2.0 bar.

  At higher engine speeds oil pressure must not exceed 7.0 bar

If specifications are not obtained:

- Mechanical damage possible, e.g. repair bearing damage.
- Replace oil filter bracket with pressure relief valve. See **Fig. 135** , item 4 or oil pump.

If the specification is exceeded:

- Check oil galleries.
- If necessary, replace oil filter bracket with pressure relief valve. See **Fig. 135** , item 4

GENERAL, TECHNICAL DATA

TECHNICAL DATA

Engine Code and Serial number, locations

The Engine Code number ("Code letters" plus "Serial number") can be found between the Diesel injection pump and the exhaust manifold on the engine block.

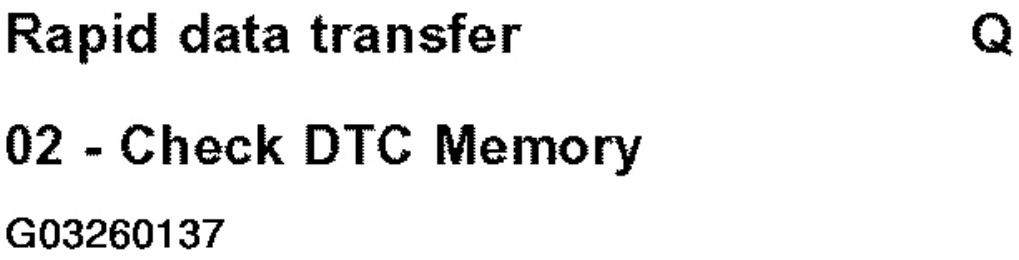


Fig. 1: Identifying Engine Code Number
Courtesy of VOLKSWAGEN OF AMERICA, INC.

There is also a sticker on the toothed belt guard showing the "Engine code" and "Serial number".

The Engine Code is also included on the vehicle data plate.

Engine data

ENGINE DATA

Engine Code letters	**ALH**
Production	from 10.97
Displacement liters	1.9
Power kW at 1/min	66/3750
Torque N.m at 1/min	210/1900
Bore diameter mm	79.5
Stroke mm	95.5
Compression	19.5

CZ (Cetane rating) minimum	45
Ignition sequence	1 - 3 - 4 - 2
Catalytic converter	YES
Exhaust Gas Recirculation	YES (1)
Turbocharging	YES
Charge Air cooling	YES
(1) With EGR cooling	

ENGINE - ASSEMBLY

ENGINE, REMOVING AND INSTALLING

Special tools and equipment

- 2024 A Engine sling
- T10012 Engine/trans. support
- VW 313 Holding fixture
- VW 540 Holding fixture / transmission support
- VAG 1202 A Workshop crane
- VAG 1306 Drip tray for VAG 1202A

Fig. 2: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG 1331 Torque wrench: 5 to 50 Nm (3.7 to 37 ft lb)
- VAG 1332 Torque wrench 40 to 200 Nm (30 to 148 ft lb)
- VAG 1383A Engine/transmission jack
- VAG 1921 Hose clip pliers
- VAS 5085 Step ladder
- G 000 100 grease (manual transmission only)
- M10 x 25 / 8.8 Bolt

- Cable tie

Fig. 3: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

CAUTION: Obtain the radio anti-theft code from the customer BEFORE disconnecting the battery Ground strap.

NOTE:

- **After making sure that the ignition is switched OFF, disconnect the battery Ground strap.**
- **All cable ties which were opened or cut open to remove the engine/transmission assembly, must be replaced in the original position when installing the engine.**
- **Remove the engine/transmission assembly downward.**
- **Remove the engine cover.**
- **Remove power steering reservoir from battery support, thereby not having to loosen the fluid hoses.**
- **Attach coolant reservoir to upper radiator support.**
- **Remove the battery and battery hold-down.**
- **Remove Air Cleaner.**
- **Remove connecting pipe between the Charge Air cooler and intake manifold complete with EGR Vacuum Regulator solenoid valve -N18-.**

- Disconnect fuel supply and return lines at fuel filter.

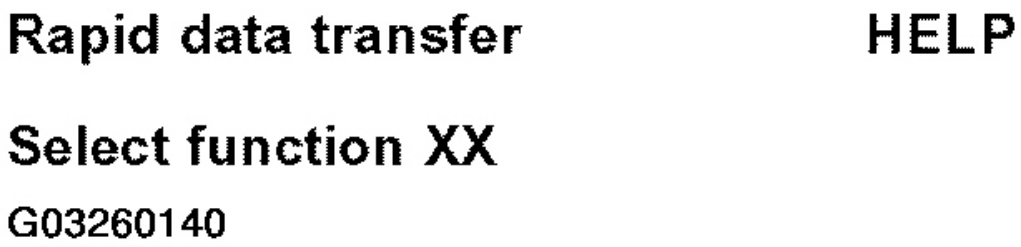


Fig. 4: Disconnecting Fuel Supply And Return Lines
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Seal off lines so fuel system is not contaminated by dirt etc.

Vehicles with manual transmission

- Disconnect selector mechanism from transmission.

See **SELECTOR MECHANISM ON TRANSMISSION SIDE, UP TO 5.99 DISASSEMBLING AND ASSEMBLING** or **SELECTOR MECHANISM ON TRANSMISSION SIDE, AS OF 6.99 DISASSEMBLING AND ASSEMBLING** .

- Remove hydraulic clutch slave cylinder:

See **CLUTCH SLAVE CYLINDER**

Vehicles with automatic transmission

- Remove Transmission Range selector lever cable from transmission:

See **SELECTOR LEVER CABLE**

All vehicles

- Remove sound dampening tray:

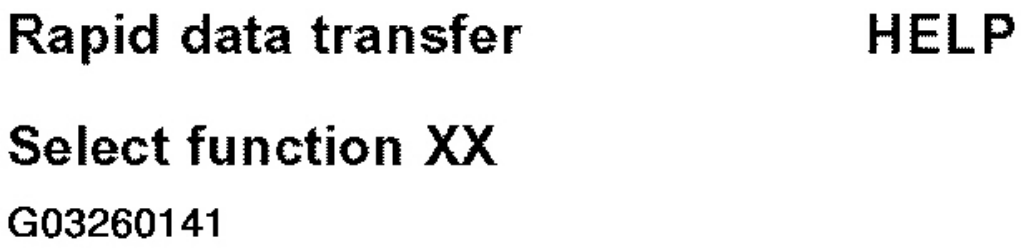


Fig. 5: Removing Sound Dampening Tray
Courtesy of VOLKSWAGEN OF AMERICA, INC.

See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Drain engine coolant. See **COOLING SYSTEM, DRAINING AND FILLING**
- Remove line between charge air cooler and turbocharger.
- Pull radiator hoses off engine using VAG 1921 hose clip pliers.
- Remove lower coolant hose from radiator.
- Remove auxiliary filter, if available, on right side of vehicle.
- Loosely unscrew pendulum support (arrows).

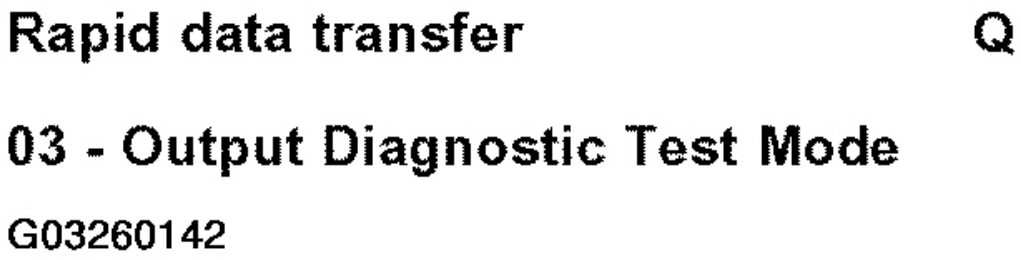


Fig. 6: Removing Pendulum Support Screw
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pull vacuum and breather hoses off engine.
- Disconnect all wiring from the transmission, Generator and starter and move them to one side for clearance.

- Remove front exhaust pipe. See **FRONT EXHAUST PIPE AND CATALYST WITH ATTACHMENTS**
- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove power steering pump with bracket and lay to one side.
- Hoses remain connected:

See **POWER STEERING PUMP, RESERVOIR, HYDRAULIC LINES** .

- Remove right hand inner Constant Velocity joint protective cover from engine if installed.
- Remove right-hand drive shaft and disconnect left-hand drive shaft at transmission:

See **FRONT AXLE SHAFT** .

- Unscrew mounting bolts for power steering pressure line.

Vehicles with A/C:

- Observe additional information and removal instructions. See **VEHICLES WITH A/C, ADDITIONAL INFORMATION AND REMOVAL INSTRUCTIONS** .
- Remove starter.

See appropriate STARTERS article.

All vehicles:

- Insert engine bracket 3396 into VAG 1383 A engine / transmission jack.
- Remove coolant hose bracket and lower from cylinder block.
- Thread hole is used to fasten T 10012 engine bracket
- Thread on T 10012 engine bracket using M10x 25 5/ 8.8 nut and bolt.

Output Diagnostic Test Mode

Loudspeaker

G03260143

Fig. 7: Threading On T 10012 Engine Bracket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Attach to engine block with 25 Nm (18 ft lb)

- Slightly lift engine/transmission assembly using VAG 1383 A jack.
- Loosely unscrew engine mount (engine side) from top of engine bracket (arrows).

Fig. 8: Removing Engine Mount Screw
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Use VAS 5085 tool to remove the mounting bolts.

- Loosely unscrew engine mount/transmission mount from transmission bracket (arrows) from top.

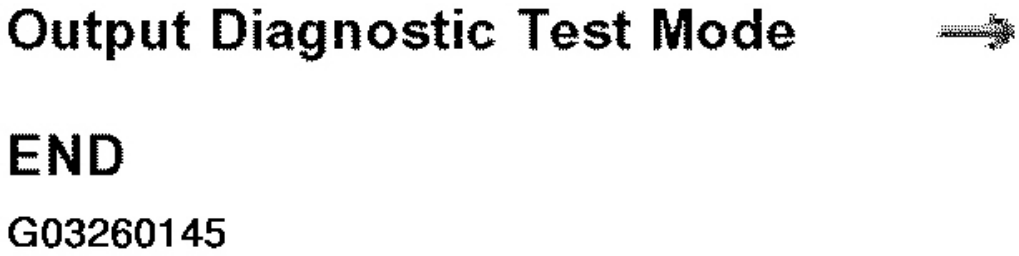


Fig. 9: Removing Engine Mount/Transmission Mount Screw
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully lower engine/transmission assembly.

- While lowering, carefully guide the power steering fluid line past the transmission.

NOTE: Carefully guide the engine and transmission assembly during the lowering process to prevent bodywork damage.

Engine assembly stand, attaching engine

NOTE: To work on the engine outside of the vehicle, attach engine to assembly stand using the VW 313 holding fixture along with the VW 540 engine/transmission support.

Work sequence

- Transfer Engine/transmission subassembly to workbench via VAG 1383 A engine/transmission jack.

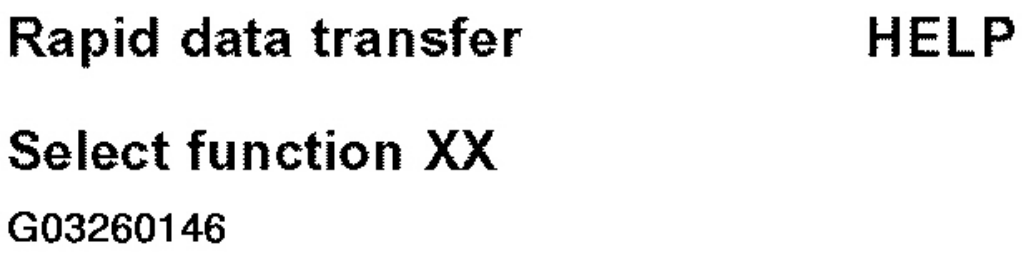


Fig. 10: Identifying Transfer Engine/Transmission Subassembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lower the engine/transmission assembly such that the transmission is supported.
- Remove lower engine/transmission connecting bolt.
- Push transmission off engine, while pushing the torque converter out of the drive plate.

Vehicles with automatic transmission

- Remove nut from torque converter.
- Clamp off ATF cooler hoses and disconnect at transmission cooler.
- Seal off transmission cooler using clean plugs.
- Secure torque converter to prevent it from falling out.

All vehicles

- Attach 2024A engine sling using 2024 A/1 extension as follows and lift from VAG 1383 engine/transmission jack using workshop crane:
  - Pulley end: 4th hole in hook at position 1
  - Flywheel end: 4th hole in hook at position 8

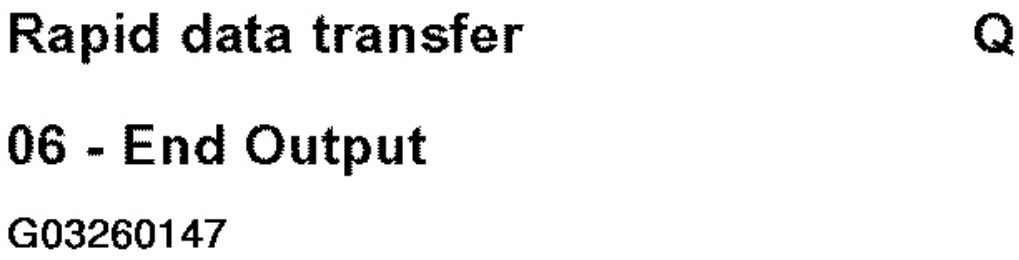


Fig. 11: Attaching 2024A Engine Sling
Courtesy of VOLKSWAGEN OF AMERICA, INC.

WARNING: Secure ALL hooks and locating pins with lock pins!

NOTE:

- **Positions marked 1 to 4 on the bar must be located toward the pulley end of the engine.**
- **The holes in the hooks are counted up from the hook.**

- Secure engine to holding fixture VW 313 using VW 540 engine/transmission support and VW 540/1 supplementary kit.

Installation notes

Installation is reverse of removal, note the following during installation:

- Check whether centering dowels for engine/transmission are installed in the cylinder block, install if necessary.
- Install intermediate plate onto sealing flange and slide onto dowel sleeves (arrows).

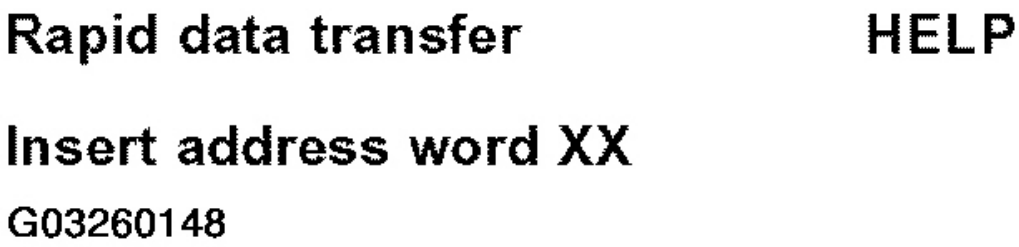


Fig. 12: Installing Intermediate Plate Onto Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with manual transmission

- Check clutch release bearing for wear, replace if necessary.
- Lightly grease clutch release bearing, release bearing guide sleeve and splines on input shaft using G 000 100.
- Install hydraulic clutch slave cylinder:

See **CLUTCH SLAVE CYLINDER**

- Install selector mechanism:

See **SELECTOR MECHANISM** .

- If necessary adjust gear change cables:

See **SELECTOR MECHANISM** .

Vehicles with automatic transmission

- Replace the lock washer on the selector cable anchorage.
- Install selector cable on transmission, adjust if necessary:

See **SELECTOR LEVER CABLE** .

All vehicles

- When installing the engine and transmission assembly, make sure sufficient clearance to drive shafts.
- While raising, carefully guide the power steering fluid line past the transmission.
- Engine and Transmission subassembly is aligned transversely so there is a distance between engine

mount -1- and engine bracket -2- of approx. 10 mm (installed condition).

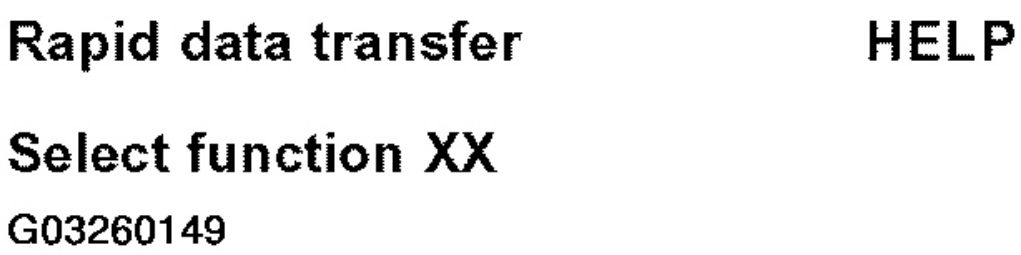


Fig. 13: Aligning Engine Mount And Engine Bracket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- When bolting the mount support arm to the engine support and transmission console, the engine and transmission mount must not be stressed (aligned parallel to each other).

Tightening torques. See **TIGHTENING TORQUES** .

- Remove left-hand drive shaft and disconnect right-hand drive shaft at transmission:

See **FRONT AXLE SHAFT** .

- Remove front exhaust pipe. See **FRONT EXHAUST PIPE AND CATALYST WITH ATTACHMENTS.**
- Remove connecting pipe between charge air cooler and intake manifold with EGR Vacuum Regulator solenoid valve.
- Install power steering pump:

See **POWER STEERING PUMP: VEHICLES WITH POWER STEERING IN LOWER SECTION, REMOVING AND INSTALLING** or **POWER STEERING PUMP: VEHICLES WITH POWER STEERING IN UPPER SECTION, REMOVING AND INSTALLING** .

- Electrical connections and routing:

See appropriate WIRING DIAGRAM article

- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Install sound dampening tray:

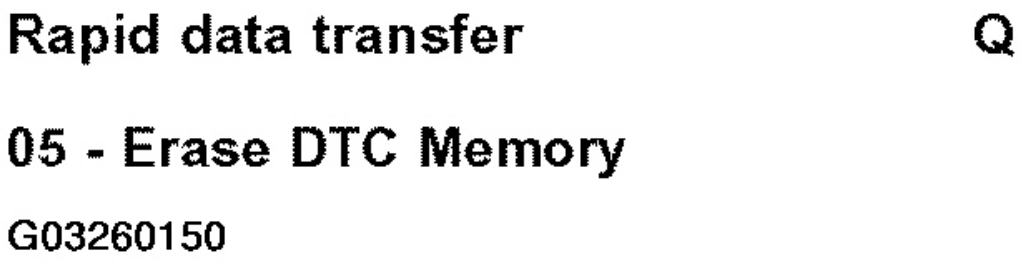


Fig. 14: Installing Sound Dampening Tray
Courtesy of VOLKSWAGEN OF AMERICA, INC.

See **NOISE INSULATION, ASSEMBLY OVERVIEW** .

- Fill with engine coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .

Tightening torques

TIGHTENING TORQUE CHART - ENGINE REMOVAL & INSTALLATION

Bolted joint	Metric Size	Tightening torque
Bolts, nuts	M 6	10 Nm 7 ft lb
	M 8	25 Nm 18 ft lb
	M10	40 Nm 30 ft lb
	M 12	60 Nm 44 ft lb
Variations on the above:		
Engine to transmission M12 connecting bolts		80 Nm 59 ft lb
Torque converter to drive plate		60 Nm 44 ft lb
Drive shaft to flange / transmission		40 Nm 30 ft lb
Front exhaust pipe to turbocharger		25 Nm 18 ft lb

Engine and transmission assembly, mountings

Tightening torques

NOTE: **The FRONT ENGINE/TRANSMISSION MOUNT TIGHTENING TORQUE CHART table refers to items in Fig. 15 .**

FRONT ENGINE/TRANSMISSION MOUNT TIGHTENING TORQUE CHART

Application	Specfication
1 - Mount to body (1)	40 Nm (30 ft lb) + 90° (1/4 turn.)
2 - Mount/bracket to body	25 Nm (18 ft lb)
3 - Mount to engine bracket (1)	60 Nm (44 ft lb) + 90° (1/4 turn.)
(1) Replace bolts	

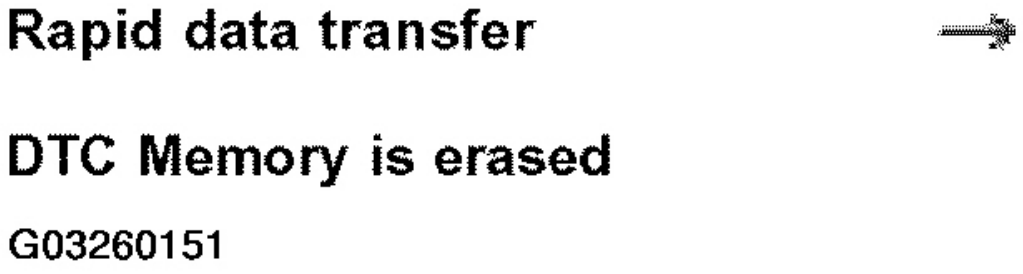


Fig. 15: Identifying Front Engine/Transmission Mount
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: **The RIGHT REAR ENGINE/TRANSMISSION MOUNT TIGHTENING TORQUE CHART table refers to items in Fig. 16 .**

RIGHT REAR ENGINE/TRANSMISSION MOUNT TIGHTENING TORQUE CHART

Application	Specification
1 - Mount to body (1)	40 Nm (30 ft lb) + 90° (1/4 turn.)
2 - Mount to body	25 Nm (18 ft lb)
3 - Mount to transmisison console (1)	60 Nm (44 ft lb) + 90° (1/4 turn.)
(1) Replace bolts	

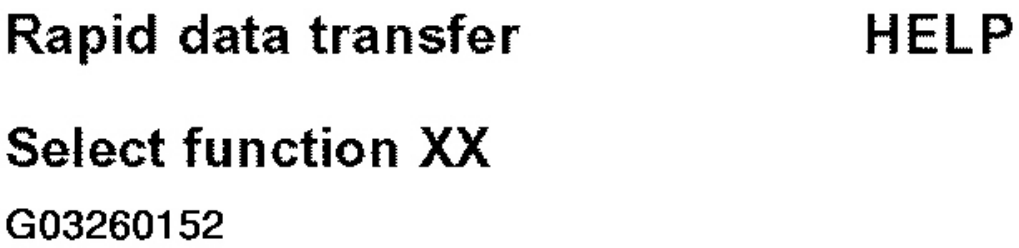


Fig. 16: Identifying Right Rear Engine/Transmission Mount
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The PENDULUM SUPPORT TIGHTENING TORQUE CHART table refers to items in Fig. 17 .

PENDULUM SUPPORT TIGHTENING TORQUE CHART

Application	Specification
1 - Pendulum support to transmission (1)	40 Nm (30 ft lb) + 90° (1/4 turn.)
2 - Pendulum support to transmission (1)	40 Nm (30 ft lb)+ 90° (1/4 turn.)
3 - Pendulum support to engine (1)	20 Nm (15 ft lb) + 90° (1/4 turn.)
(1) Replace bolts	

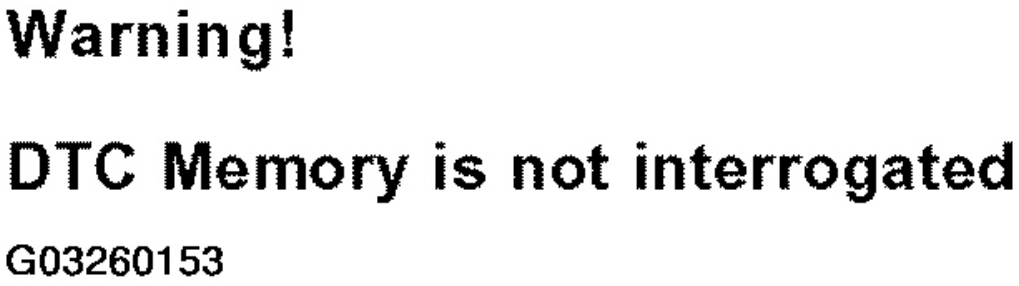


Fig. 17: Identifying Pendulum Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with A/C, additional information and removal instructions

WARNING: Do NOT open the A/C refrigerant circuit.

NOTE: To prevent damage to the condenser and to the refrigerant lines/hoses, make sure that the lines and hoses are not stretched, kinked or bent.

To ease engine removal and installation without opening the A/C refrigerant circuit:

- Remove retaining clamp(s) from refrigerant lines.
- Remove A/C compressor:

See **A/C REFRIGERANT SYSTEM, SERVICING** , item 13.

- Attach A/C compressor to vehicle body to provide stress relief for refrigerant lines/hoses.

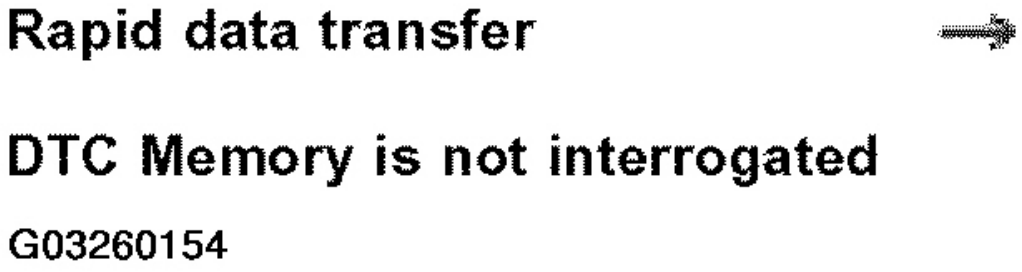


Fig. 18: Attaching A/C Compressor To Vehicle Body
Courtesy of VOLKSWAGEN OF AMERICA, INC.

ENGINE - CRANKSHAFT, CYLINDER BLOCK

ENGINE, DISASSEMBLING AND ASSEMBLING

NOTE:

- **If during repairs, metal shavings or quantities of small metal particles are found in the engine oil - caused, for example, by partial seizure of the crankshaft and conrod bearings - then, besides thoroughly cleaning out the oil passages, also replace the oil cooler.**
- **Faulty injectors can cause violent knocking noises in the engine which sound like faulty bearings. When this occurs, run engine at idle and slacken off the injector line unions one after the other. If the knocking stops when a specific union is loosened, this is an indication that the**

respective injector is faulty.

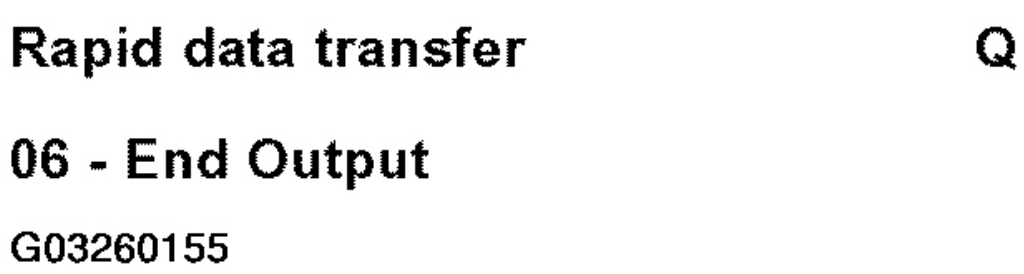


Fig. 19: Locating External Engine Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Fuel injectors, servicing

See **FUEL INJECTORS, SERVICING** .

I. See **PART I**
II. See **PART II**

Part I

NOTE: The following list refers to items in Fig. 20 .

1. **Ribbed belt**
   - Mark direction of engine rotation before removing
   - Removing and installing: See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
   - Vehicles with A/C with additional idler pulley, removing and installing: See **Pulley, removing and installing**
2. **10 N.m (7ft lb) plus additional 1/4 turn (90°)**
3. **Belt pulley/vibration damper**
   - Can only be installed in one position; holes are offset
4. **25 N.m (18 ft lb)**
5. **Tensioning element**
   - For V-belt
   - Turn with open-end wrench to loosen ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**

6. **Generator**
7. **Assembly bracket**
    - for injection pump, Generator and power steering pump
    - for vehicles with A/C
    - Assembly bracket for vehicles with A/C, removing and installing:

    See **1.9L4-CYLINDER TDI ENGINE**

8. **45 N.m (33 ft lb)**
9. **Banjo bolt**
    - 30 N.m (22 ft lb)
10. **Seal**
    - Always replace
11. **Pressure accumulator**
12. **Flange**
    - For power steering
    - Removing and installing:

    See **POWER STEERING PUMP IN LOWER SECTION, ASSEMBLY OVERVIEW** or **POWER STEERING PUMP IN UPPER SECTION, ASSEMBLY OVERVIEW**

13. **Pulley**
    - For Engine Coolant pump

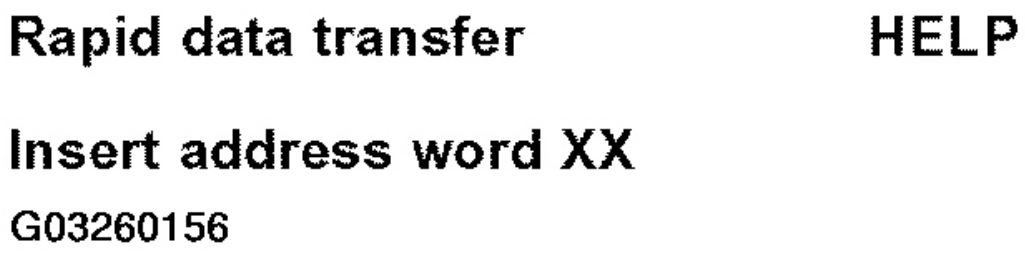


Fig. 20: Identifying Engine Components - Accessory Drive (Part 1)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Pulley, removing and installing

Only for vehicles with A/C

Removing

- Remove sound dampener tray

  See **NOISE INSULATION, ASSEMBLY OVERVIEW** .

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Pry off cover -1- using screwdriver.
- Remove mounting bolts -2- and remove pulley -3-.

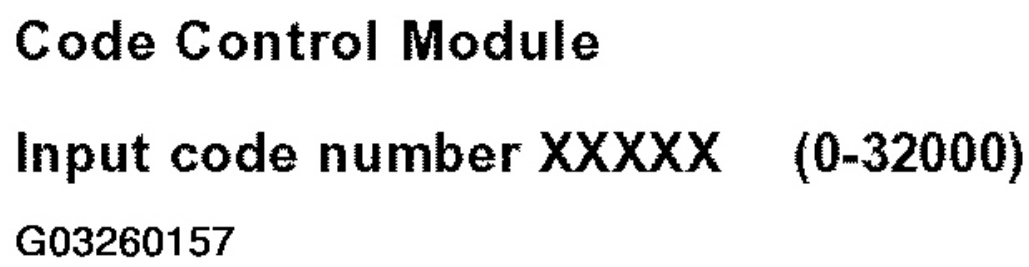


Fig. 21: Removing Ribbed Belt Pulley (Vehicles with A/C)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

- Position pulley -3- and tighten mounting bolt
  - Tightening torque 25 N.m (18 ft lb)
- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
- Install sound dampener tray.

  See **NOISE INSULATION, ASSEMBLY OVERVIEW**

Part II

NOTE: The following list refers to items in Fig. 22 .

1. **120 N.m (88 ft lb) plus additional 1/4 turn (90°)**
   - Always replace
   - To loosen and tighten, counter-hold with 3099
   - Threads and shoulder must be free of oil and grease
   - The additional quarter turn can be obtained in several stages.

2. **40 N.m (30 ft lb) plus additional 1/4 turn (90°)**
    - Always replace
3. 15 N.m (11 ft lb)
4. 22 N.m (16 ft lb)
5. **Toothed belt guard, lower section**
6. **10 N.m (7 ft lb)**
7. **Toothed belt guard**
8. **45 N.m (33 ft lb)**
9. **Right engine bracket**
10. **Toothed belt guard, upper section**
11. **Toothed belt**
    - Mark engine direction of rotation before removing
    - Check for wear
    - Do not kink
    - Removing, installing and tensioning. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING** .
12. **Idler wheel**
13. **20 N.m (15 ft lb) plus additional 1/4 turn (90°)**
    - Always replace
14. **20 N.m (15 ft lb)**
15. **20 N.m (15 ft lb)**
16. **45 N.m (33 ft lb)**
17. **Camshaft sprocket**
    - Drive camshaft off of taper using hammer and drift through toothed belt guard openings
    - to loosen and tighten bolt (item 16), counterhold using 3036
18. **Tensioning roller**
    - Semi-automatic toothed belt tensioning roller, checking. See **SEMI-AUTOMATIC TOOTHED BELT TENSIONING ROLLER, CHECKING** .
19. **Idler wheel**
20. **Injection pump sprocket**
    - Two piece construction
21. **30 N.m (22 ft lb)**
22. **Toothed belt guard, rear**
23. **Coolant pump**
    - Removing and installing. See **COOLANT PUMP, REMOVING AND INSTALLING** .
24. **Idler wheel**
    - First remove, to remove coolant pump
    - Removing and installing. See **COOLANT PUMP, REMOVING AND INSTALLING**

25. **Crankshaft toothed belt sprocket**
26. **Bushing**
27. **Diesel injection pump**
    - Removing and installing

    See **DIESEL INJECTION PUMP, SERVICING** .

28. **Assembly bracket**
    - for Diesel injection pump, Generator and power steering pump.
    - for vehicles with A/C
    - Removing and installing

    See **1.9L4-CYLINDER TDI ENGINE** .

29. **45 N.m (33 ft lb)**

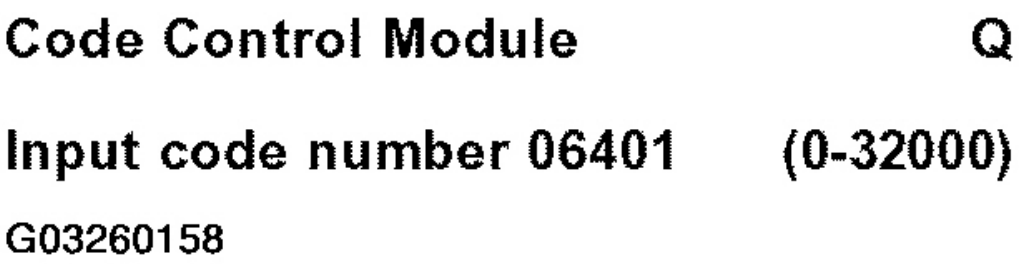


Fig. 22: Identifying Front Engine Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Ribbed belt tensioner, removing and installing

Work sequence

- Remove right-hand insulation tray:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Remove pipe between charge air cooler and turbocharger. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING** .
- Mark engine direction of rotation on ribbed belt.
- Swing tensioning roller in direction of arrow using 15 mm open end wrench on tensioning lever.

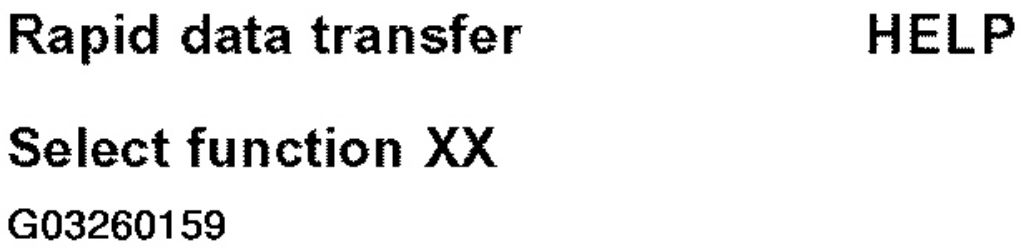


Fig. 23: Removing Or Installing Ribbed Belt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove or install ribbed belt.

NOTE:

- **Vehicles without A/C: first remove V-belt from Generator and position it last when installing.**
- **Vehicles with A/C: first remove V-belt from pulley and position it last when installing.**
- **When installing V-belt; make sure belt sits correctly in pulley.**

Ribbed belt, routing

Belt drive without A/C compressor

NOTE: The following list refers to items in Fig. 24 .

1. Vibration damper/pulley
2. Tensioner
3. Pulley - Generator
4. Ribbed belt
5. Pulley - Power steering pump

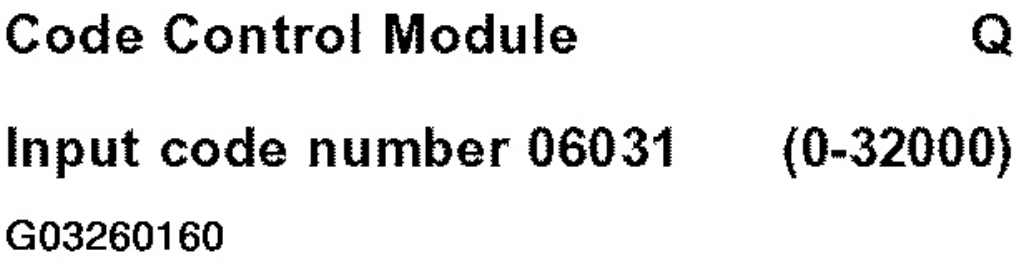


Fig. 24: View Of Belt And Pulleys
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Belt drive with A/C compressor

NOTE: The following list refers to items in Fig. 25 .

1. Vibration damper/pulley
2. Tensioner
3. Pulley - Generator
4. Pulley - Power steering pump
5. Tensioner
6. Ribbed belt
7. Pulley - A/C

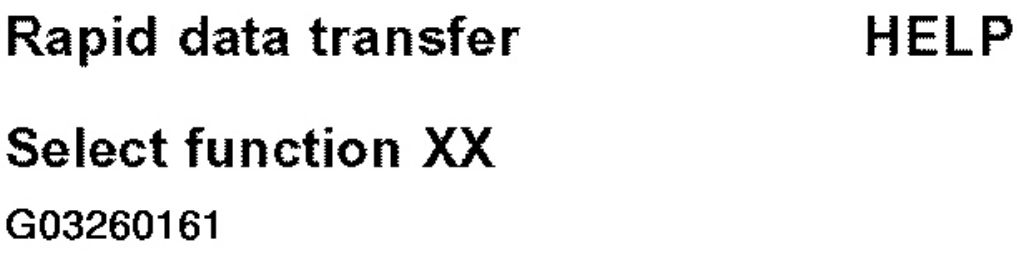


Fig. 25: Identifying Belt Drive With A/C Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Toothed belts, removing, installing, tensioning

Special tools and equipment

- 2068 A Adj. gauge TDC tool
- 3359 Rig pin
- 3418 Adjustment guide
- 10-222A Engine support bridge with 10-222A/1 bracket for engine
- V159 nut wrench
- VAG 1331 Torque wrench: 5 to 50 N.m (3.7 to 37 ft lb)

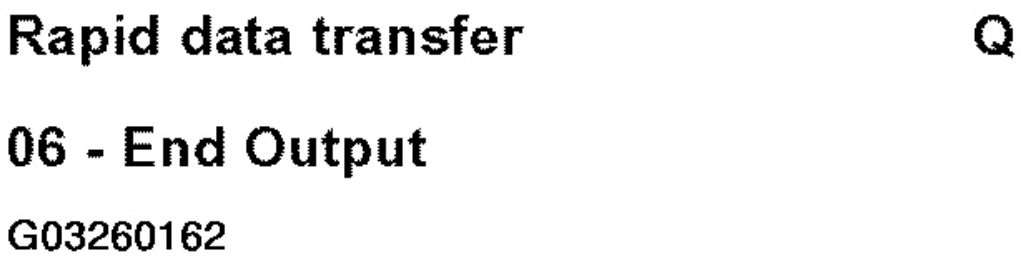


Fig. 26: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Support tool 10-222 A/21, modifications

NOTE:

- **Use tool 10-222A to support the engine / transmission assembly.**
- **Drill a new hole in the 10-222 A/21 guide to fasten 10-222 A/8 adaptor to.**

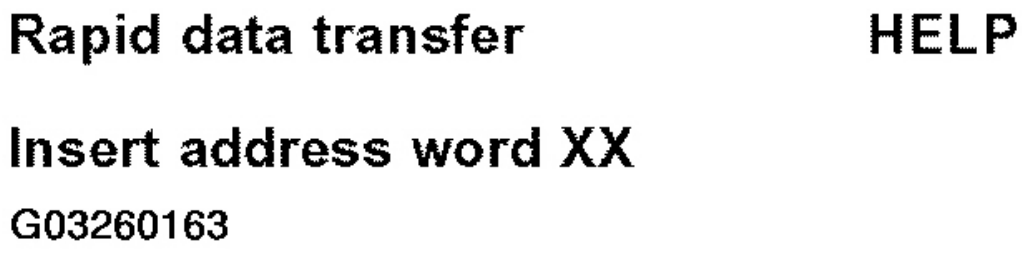


Fig. 27: Identifying New Hole On 10-222 A/21 Guide
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- **Dimensions given are in mm.**
- **One hole 12.5 mm diameter (arrow) drilled in the 10-222 A/21 guide**

Toothed belts, removing

- Remove tube between charge air cooler and Air intake pipe. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING**
- Disconnect fuel supply and return lines at fuel filter.
- Remove fuel filter from bracket.
- Remove toothed belt guard - upper section.
- Remove valve cover.

NOTE: The valve cover has an integrated, vulcanized gasket. If damaged or leaking replace the valve cover.

- Remove brake booster vacuum pump.
- Remove pipe between charge air cooler and turbocharger. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING** .
- Remove insulation tray - right side

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .

With engine installed:

- Turn crankshaft to cylinder 1 TDC.

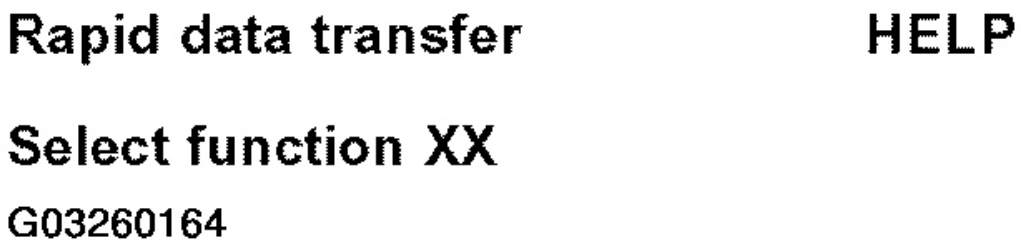


Fig. 28: Identifying Timing Mark (Manual Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to cylinder 1 TDC.

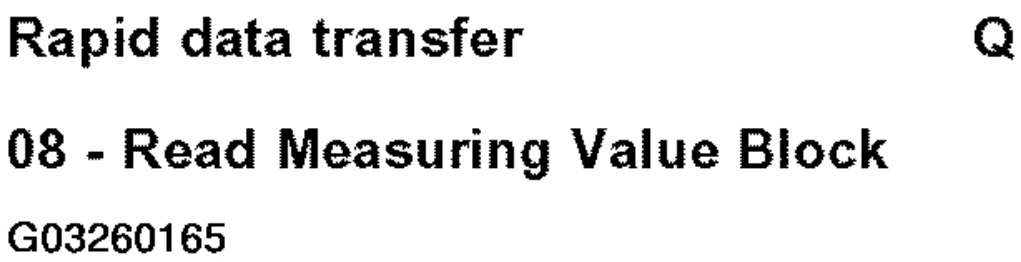


Fig. 29: Identifying Timing Mark (Automatic Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

With engine removed:

Vehicles with manual transmission

- Install adjustment device 2068 A as shown.

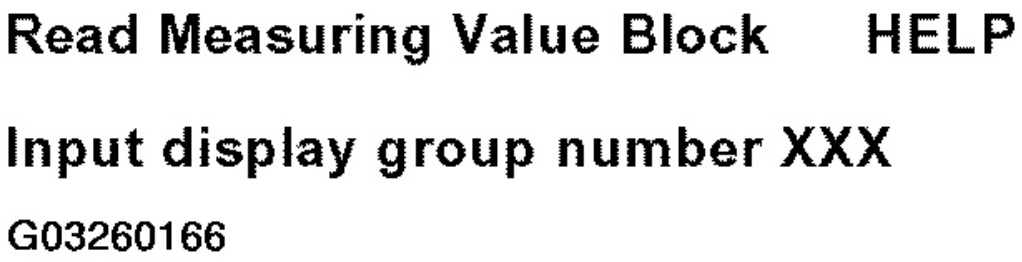


Fig. 30: Installing Adjustment Device On Flywheel
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Set adjustment device to 96 mm (arrow -A-). Left-hand notch of vernier scale is reference point.
- Turn crankshaft until flywheel TDC marking aligns with point on setting device (arrow -B-).

Vehicles with automatic transmission

- Install adjustment device 2068 A as shown.

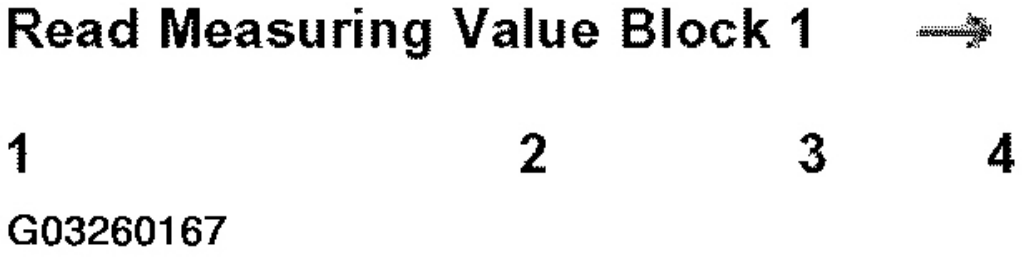
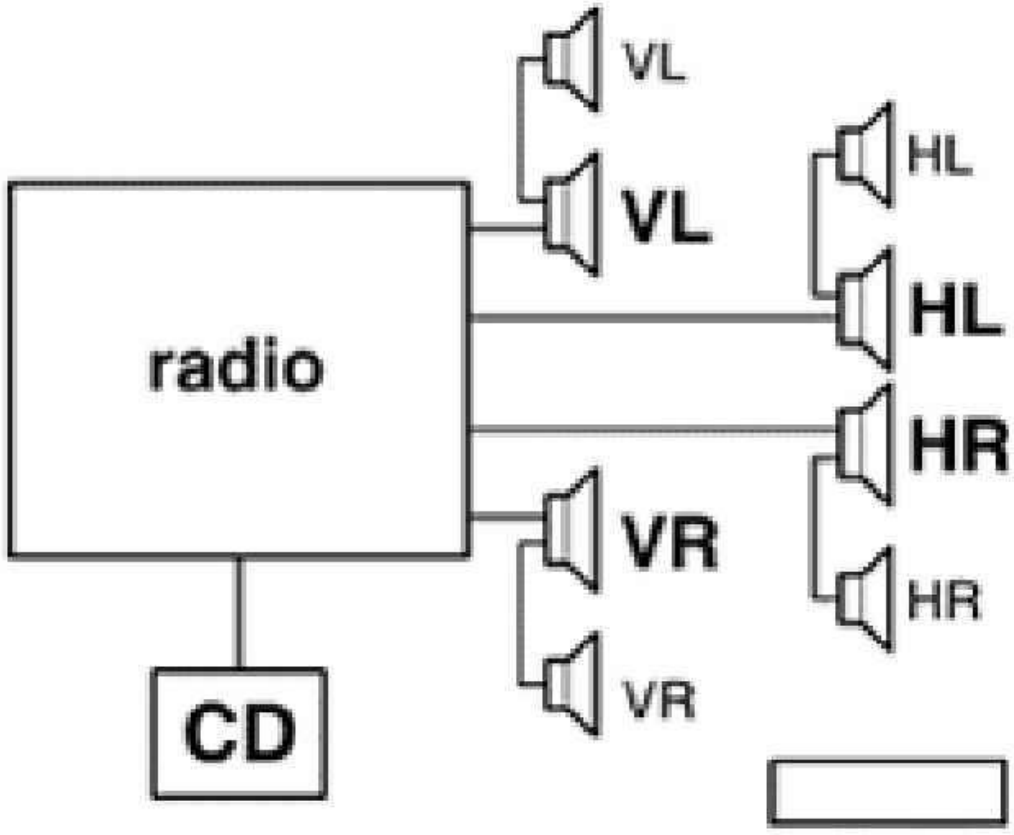


Fig. 31: Installing Adjustment Device On Flywheel
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Set adjustment device to 96 mm (arrow -A-). Left-hand notch of vernier scale is reference point.
- Turn crankshaft until flywheel TDC marking aligns with point of setting device (arrow -B-).

All vehicles

- Lock camshaft using setting bar.



VL = Left front

HL = Left rear

VR = Right front

HR = Right rear

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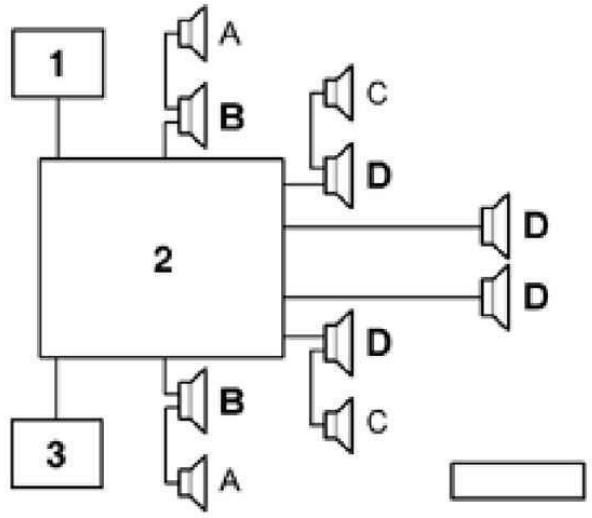
Fig. 32: Installing Setting Bar On Camshaft
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Centralize setting bar as follows:

  Turn camshaft so that one end of setting bar contacts the cylinder head. Using feeler gauge establish the gap at the other end of the setting bar. Place a feeler gauge corresponding to half the gap between setting bar and cylinder head. Turn camshaft until the setting bar contacts the feeler gauge. Place a 2nd feeler gauge, of same thickness, at the other end between setting bar and cylinder head

- Lock injection pump sprocket with pin.
- Loosen injection pump sprocket mounting bolts -1-.



1 - Amplifier

2 - Radio Monsoon

3 - CD player

A - Domed treble loudspeaker in inner plenum chamber cover

B - Bass loudspeaker in inner plenum chamber cover

C - Domed treble loudspeaker in A-pillar trim

D - Bass loudspeaker, front and rear in side panel trim

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Fig. 33: Locking Injection Pump Sprocket With Pin
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: **Do NOT loosen hub nut -2-! Otherwise the Diesel injection pump basic setting will be altered and cannot be reset with normal workshop equipment.**

- Loosen tensioner.
- Install 10-222A support with 10-222A/1 legs as shown.

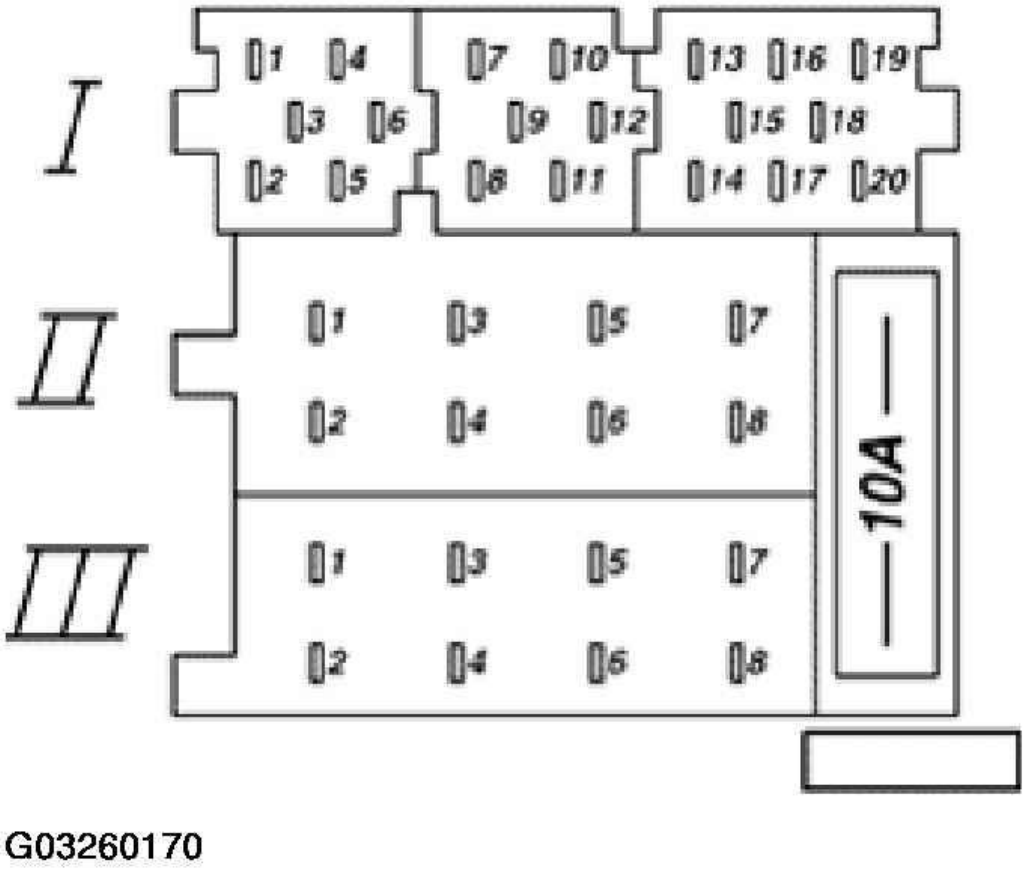


Fig. 34: Installing 10-222A Support With 10-222A/1 Legs
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove engine mount -1- as follows:
- Unscrew bolts (arrows)

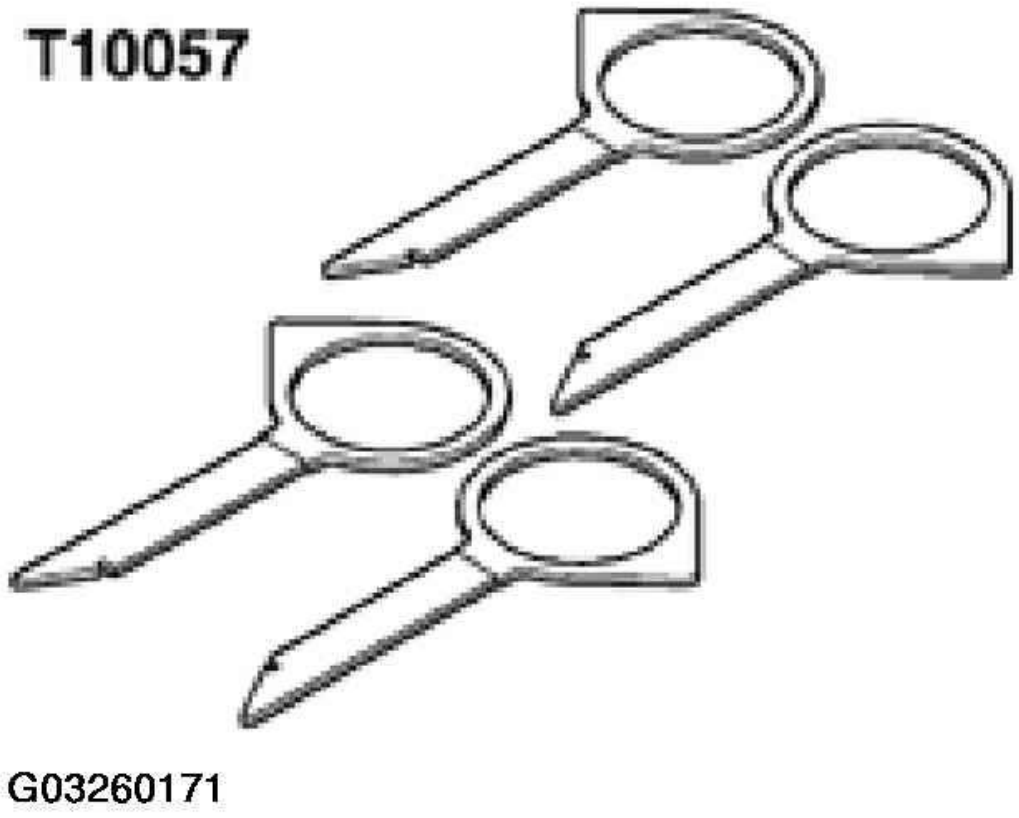


Fig. 35: Removing Engine Mount
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove vibration damper/belt pulley.
- Remove toothed belt guard center and lower sections.
- Mark engine direction of rotation on the toothed belt.
- Remove toothed belt.

Toothed belts, installing

- Make sure that TDC mark on flywheel and reference mark are aligned.
- Loosen camshaft sprocket mounting bolt 1/2 turn.
- Place a drift through hole in rear of toothed belt guard and release the camshaft sprocket from camshaft taper with a light and careful hammer blow.

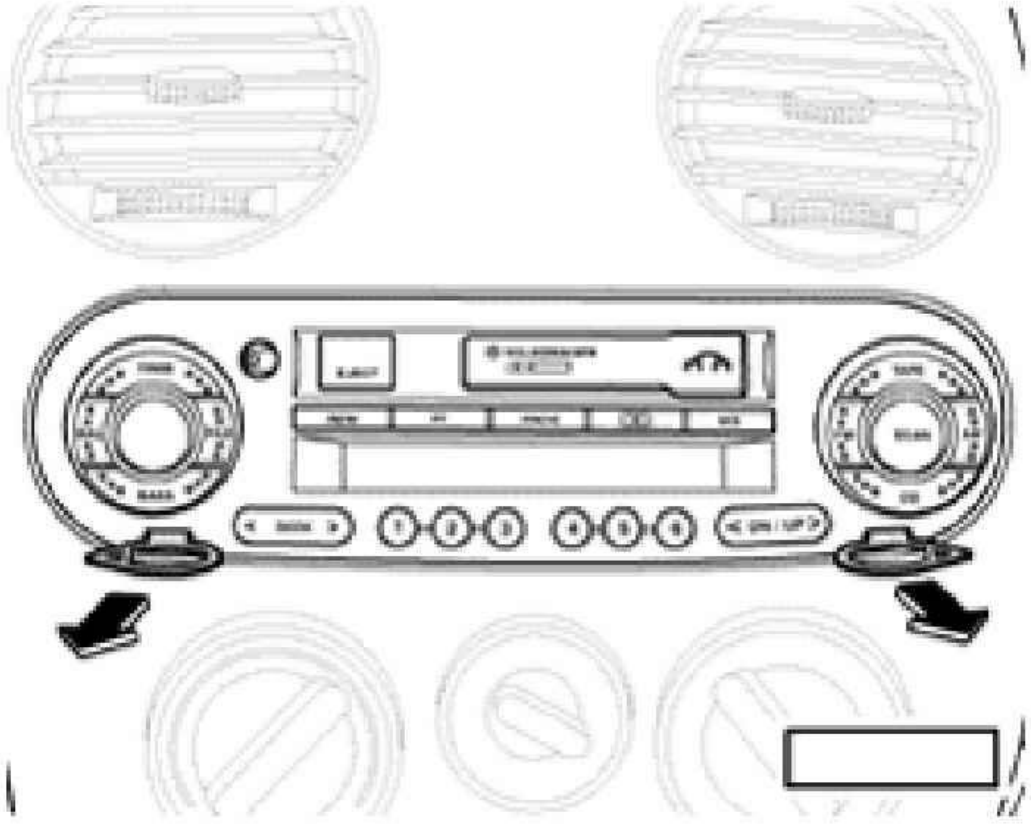


Fig. 36: Installing Drift Through Hole In Rear Of Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install toothed belts (note engine direction of rotation) on crankshaft toothed belt sprocket, intermediate wheel, injection pump sprocket and tensioning roller.
- Install camshaft sprocket together with toothed belt and position using mounting bolt.
  - Camshaft sprocket should still turn
- Tension toothed belt; using pin wrench on eccentric, turn clockwise until notch and raised mark align (arrows).

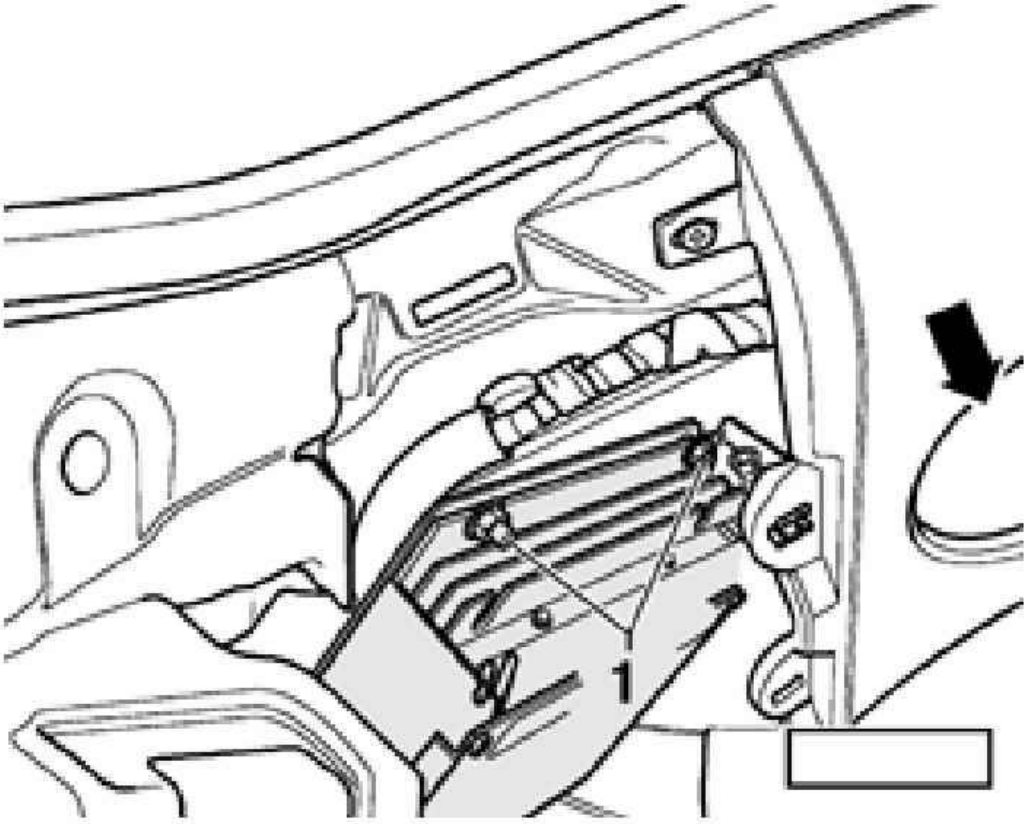


Fig. 37: Tightening Lock Nut On Tensioning Roller
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten lock nut on tensioning roller.
  - Tightening torque: 20 N.m (15 ft lb)

NOTE: Observe correct installation of tension roller in rear toothed belt guard (arrow).

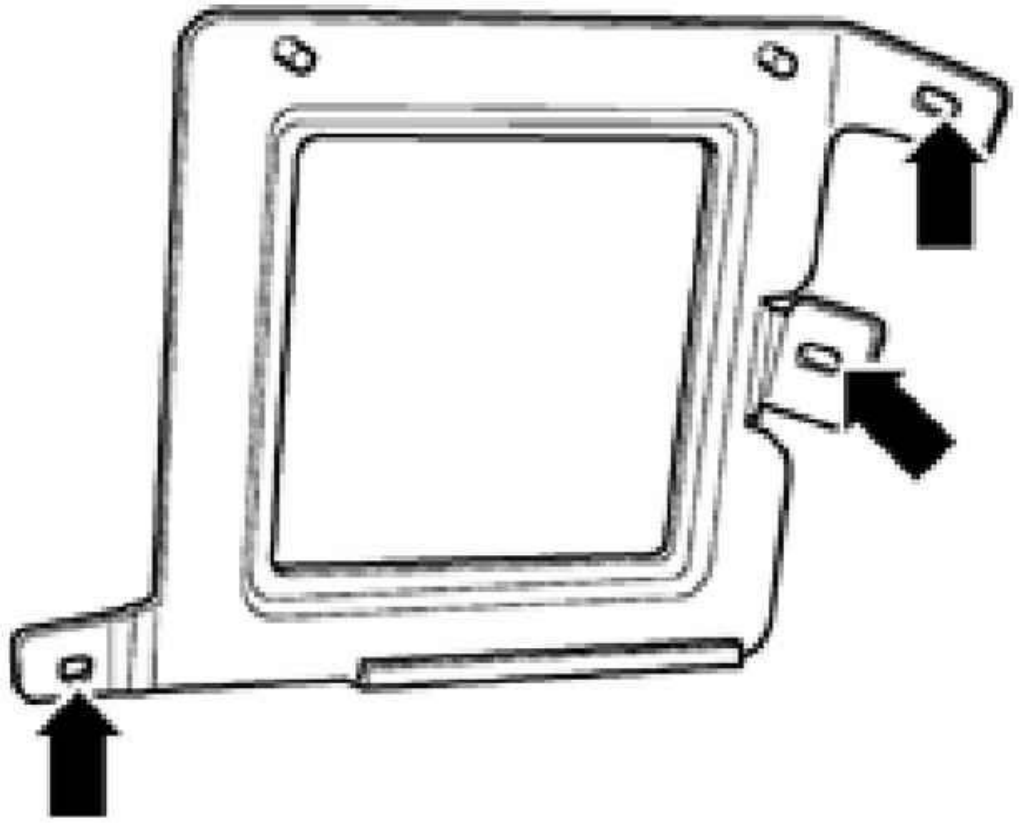


Fig. 38: Identifying Correct Installation Of Tension Roller
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check TDC mark on flywheel again.
- Tighten camshaft sprocket mounting bolt.
  - 45 N.m (33 ft lb)
- Tighten the new mounting bolts of injection pump sprocket
  - Tightening torque: 20 N.m (15 ft lb)

NOTE:

- **After dynamically checking the "start of injection", the mounting bolts must be retightened 90° (1/4 turn).**

See DIESEL INJECTION PUMP, REMOVING AND INSTALLIN

- **The mounting bolts should only be used one time, since by design they have a reduced shank**

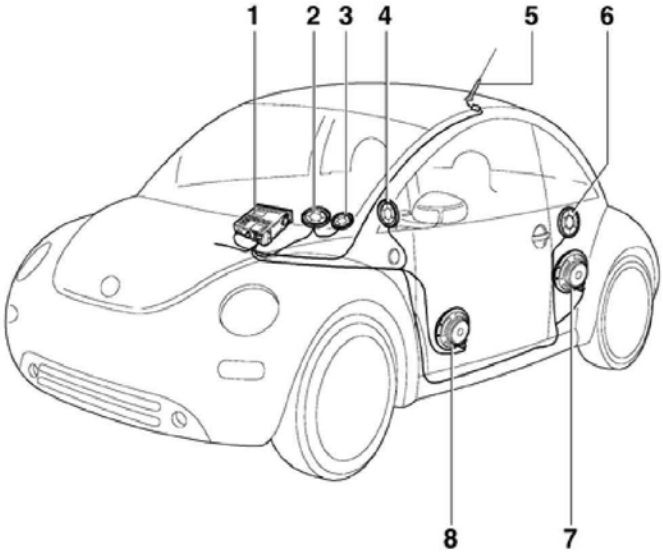
- Remove 2065A setting bar from camshaft.
- Remove pin.
- Turn crankshaft two rotations in engine direction of rotation and set again to cylinder 1 TDC.
- Attach bracket to engine block.
- Install engine mount (replace mounting bolts).
  - Tightening torque: 40 N.m (30 ft lb) plus additional 90° (1/4 turn)
- Securely install mount for engine to engine bracket (replace mounting bolts)
  - Tightening torque: 60 N.m (44 ft lb) plus additional 90° (1/4 turn)
- Install bracket for subassembly/body
  - Tightening torque: 25 N.m (18 ft lb)
- Install vacuum pump.
- Install toothed belt guard, vibration damper, belt pulley, and valve cover.
- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Install sound dampening tray and engine cover
- Remove pipe between charge air cooler and turbocharger. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING** .
- Install fuel filter with bracket
- Disconnect fuel supply and return lines at fuel filter.
- Install pipe between charge air cooler and intake pipe. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING** .
- Check Diesel injection pump "start of delivery"

  See **START OF INJECTION, DYNAMICALLY CHECKING AND ADJUSTING**

Semi-automatic toothed belt tensioning roller, checking

Test sequence

- Tighten toothed belt with firm thumb pressure.



1 - Radio

- In center console
- Removing and installing ⇒ Page 91-10

2 - Bass loudspeaker (with Monsoon only)

- In inner plenum under cover
- Removing ⇒ Page 91-22

3 - Domed treble loudspeaker (with Monsoon only)

- In inner plenum under covcer
- Removing ⇒ Page 91-22

4 - Domed treble loudspeaker

- In A-pillar
- Removing ⇒ Page 91-20

5 - Roof antenna

- Amplified mast type antenna mounted on roof ⇒ Page 91-29

6 - Not applicable

7 - Bass loudspeaker

- In rear side panel
- Removing and installing ⇒ Page 91-21

8 - Bass loudspeaker

- In front door
- Removing and instaling ⇒ Page 91-21

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Fig. 39: Tightening Toothed Belt Nut
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Notch and raised portion (arrows) must move apart.

- Release thumb pressure on toothed belt.

Tensioning roller must move back to its initial position, notch and raised portion must align again.

SEALING FLANGE AND FLYWHEEL/DRIVE PLATE, REMOVING AND INSTALLING

NOTE: For clutch repairs: See CLUTCH ASSEMBLY

NOTE: The following list refers to items in Fig. 40 .

1. **15 N.m (11 ft lb)**
2. **Oil seal**
   - Replacing. See **SEALING RING (CRANKSHAFT PULLEY SIDE), REPLACING**
3. **Sealing flange, front**
   - Must be located on dowel sleeves
   - Removing and installing. See **SEALING FLANGE (FRONT), REMOVING AND INSTALLING**
4. **Engine block**
   - Crankshaft, removing and installing. See **CRANKSHAFT, REMOVING AND INSTALLING**
   - Pistons and connecting rods, disassembling and assembling. See **PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING**
5. **Flywheel/drive plate**
   - to remove and install flywheel, counter-hold using 3067
   - Drive plate, removing and installing: See **DRIVE PLATE, REMOVING AND INSTALLING**
6. **60 N.m (44 ft lb) plus additional 1/4 turn (90°) further**
   - Always replace
7. **Intermediate plate**
   - Must be located on dowel sleeves
   - Do not damage/bend when assembling
8. **Sealing flange with oil seal**
   - Only replace as an assembly
   - Lightly oil sealing lip on oil seal

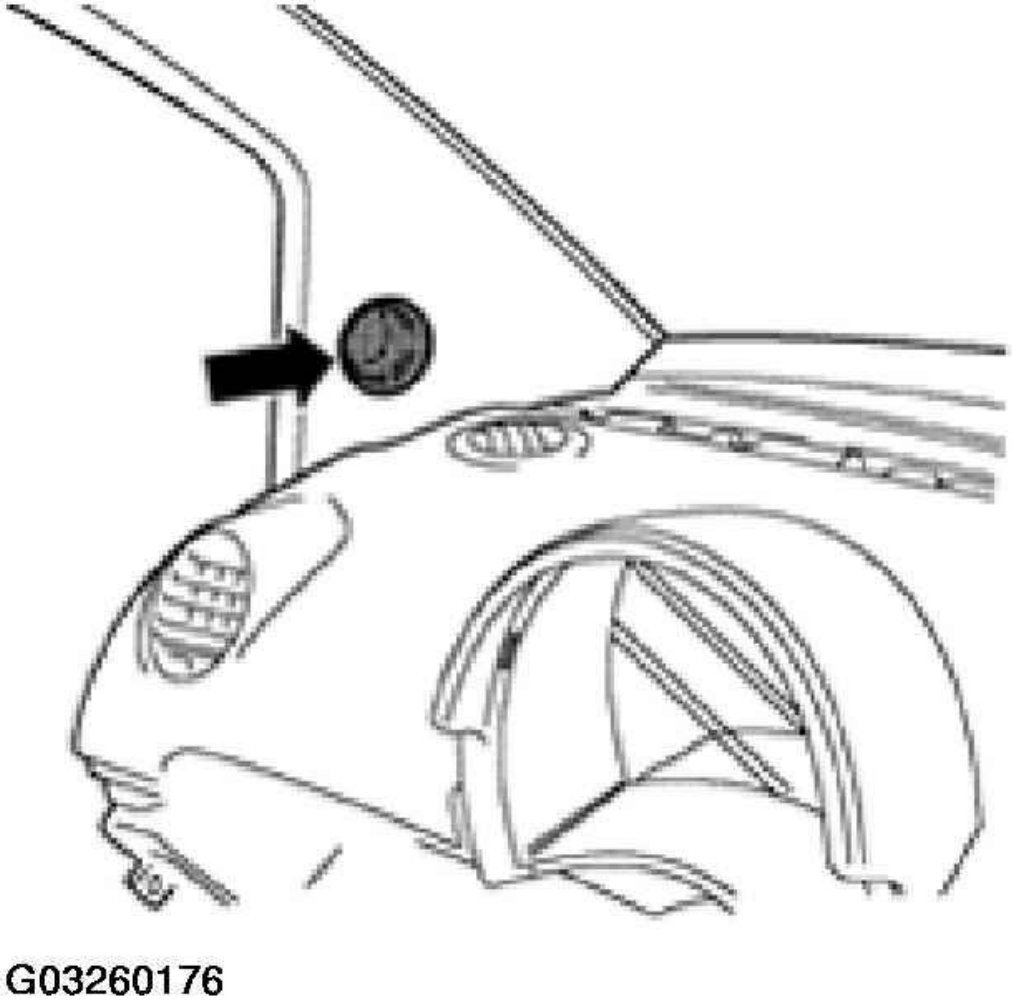

Fig. 40: Identifying Sealing Flange And Flywheel/Drive Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Sealing ring (crankshaft pulley side), replacing

Special tools and equipment

- 2080 A sleeve
- 3415 Counter support
- 3203 Seal remover
- 3265 Sleeve installer

- VAG 1331 Torque wrench: 5 to 50 N (3.7 to 37 ft lb)
- VAG 1332 Torque wrench: 40 to 200 N.m (30 to 148 ft lb)

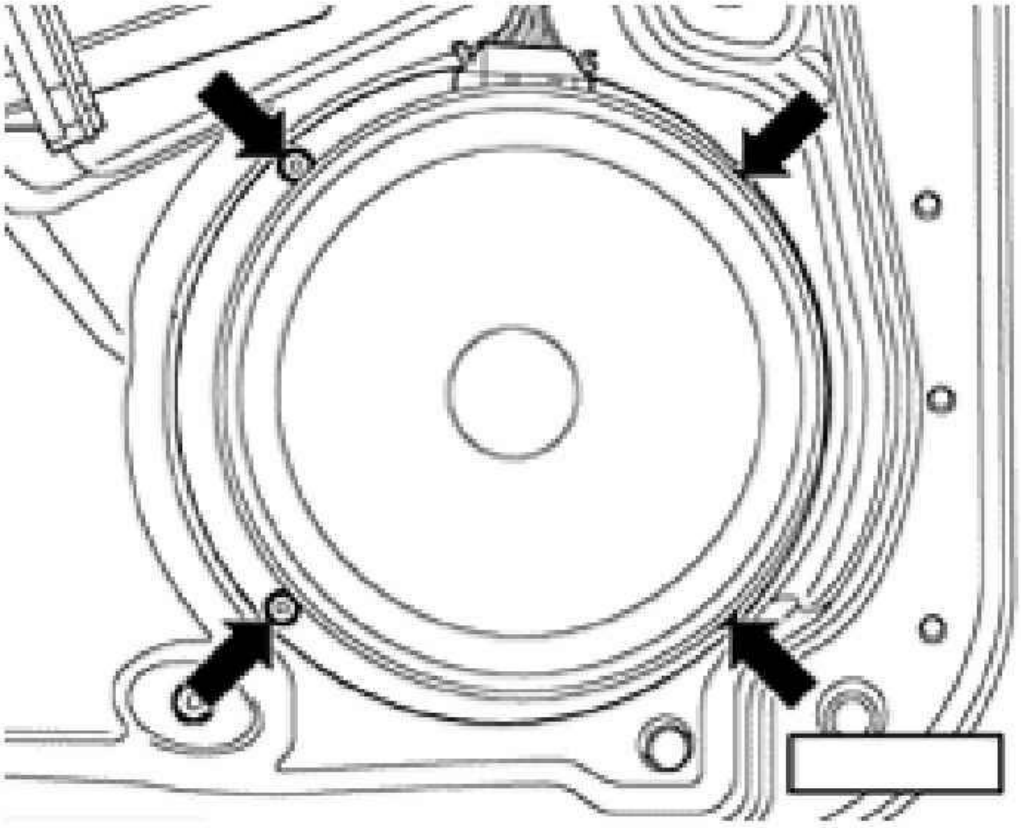

Fig. 41: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove toothed belt. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING** .
- Remove crankshaft toothed belt sprocket by counter-holding sprocket using 3415.

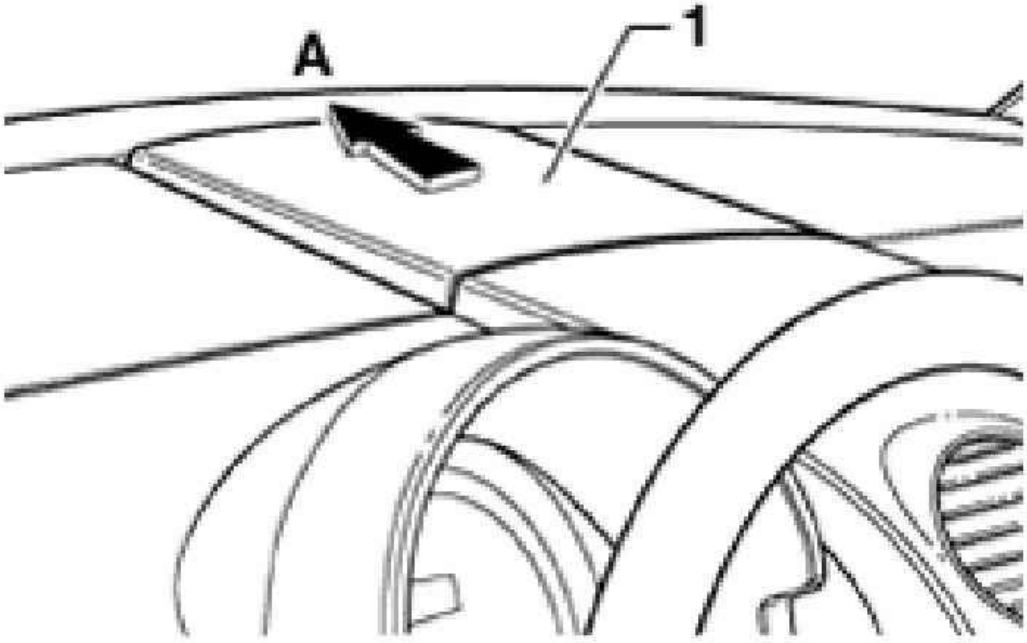

Fig. 42: Removing Crankshaft Toothed Belt Sprocket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- To guide seal extractor, hand screw center bolt into crankshaft onto stop.
- Unscrew inner part of oil seal extractor 3203 two turns (approx. 3 mm) out of outer part and lock with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and while exerting firm pressure, screw it in as far as possible into the oil seal.

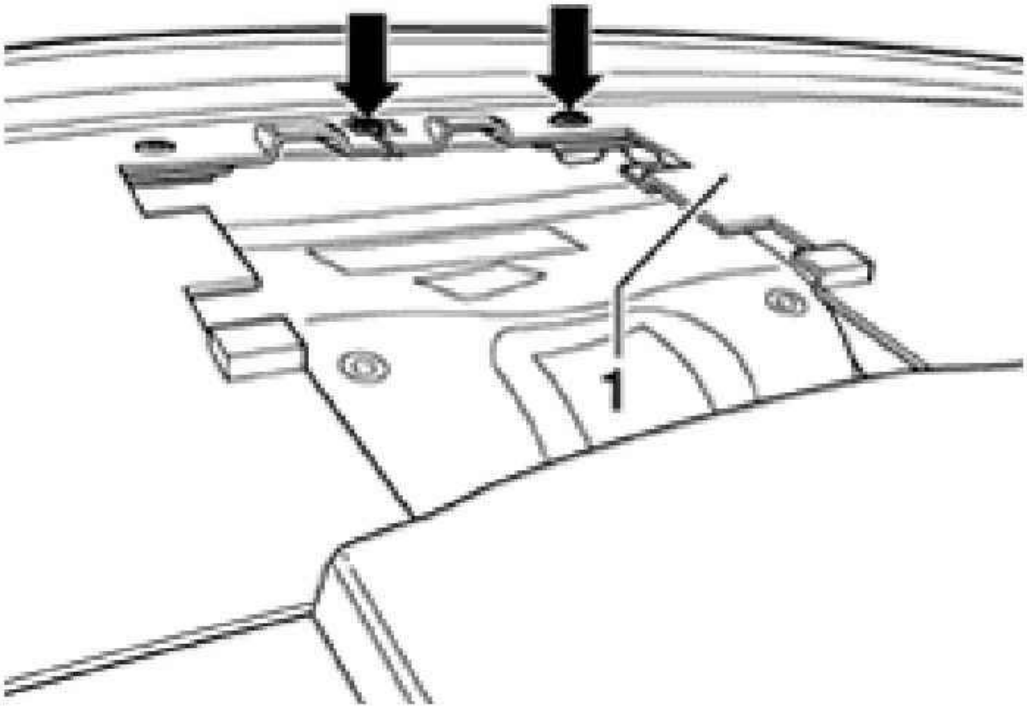

Fig. 43: Removing Oil Seal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.

Installing

- Lightly oil sealing lip of oil seal.
- Install guide sleeve from 2080 A onto crankshaft journal.

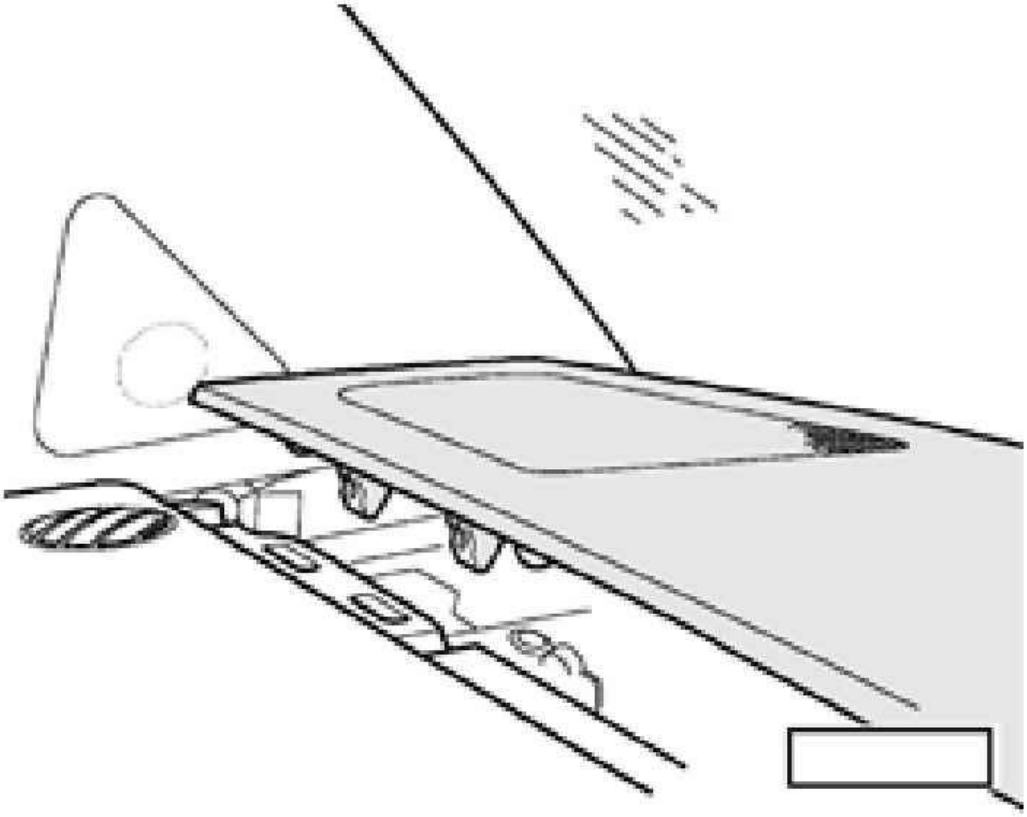

Fig. 44: Installing Guide Sleeve Onto Crankshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve.
- Press in sealing ring with press sleeve from 3265 up to the stop using center bolt -1-

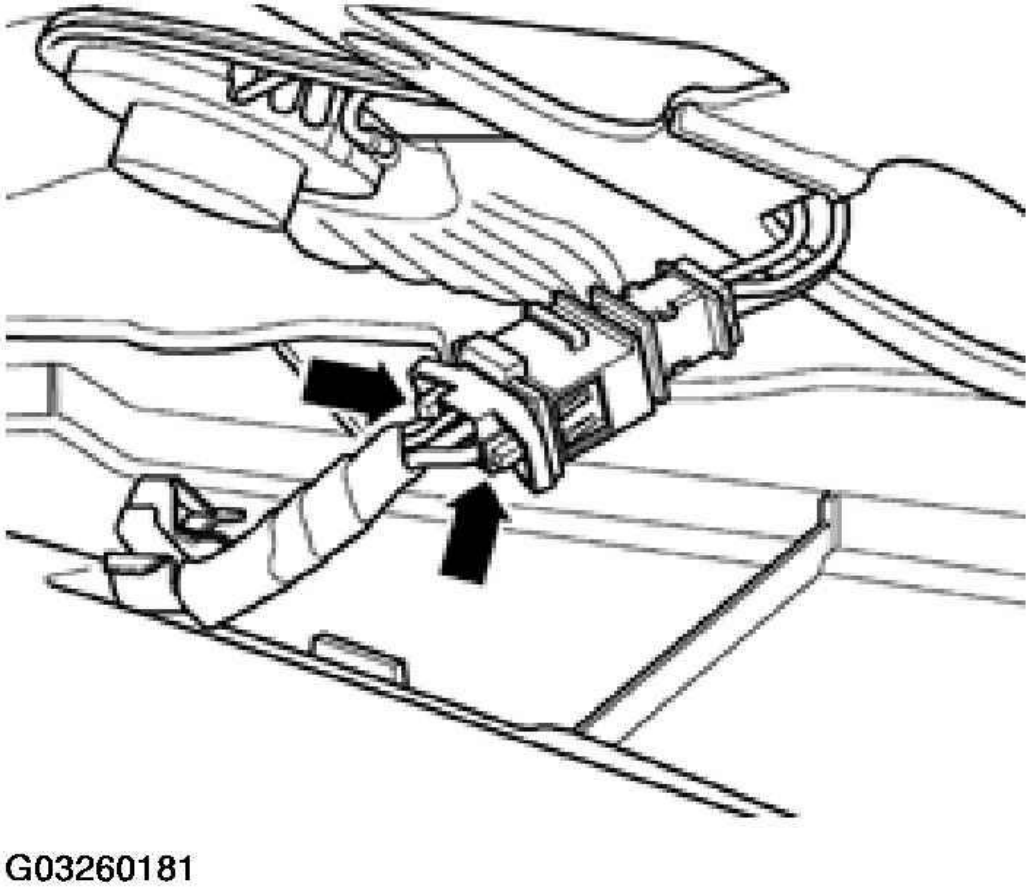

Fig. 45: Installing Sealing Ring
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install crankshaft toothed belt sprocket and hold using 3099 counterhold.
- Install toothed belt and tension. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**

Drive plate, removing and installing

Special tools and equipment

- VW 558 Counter-hold tool
- Hex bolt M8x45 and two M10 hex nuts
- Depth gauge

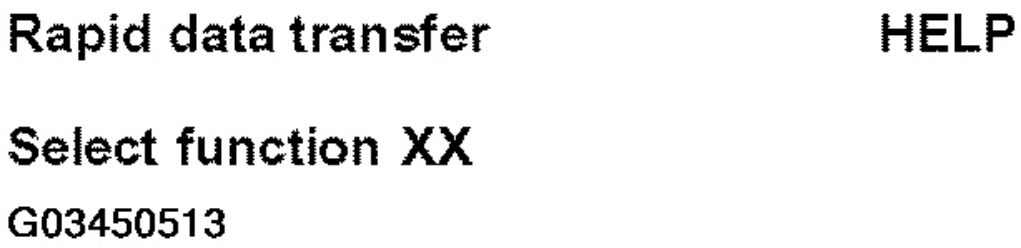

Fig. 46: Identifying VW 558 Counter-Hold Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Drive plate, loosening and tightening

- Secure VW 558 counterhold to drive plate using M8 x 45 hex bolt.
- Place two M10 hex nuts between counterhold and drive plate.

Position of counterhold tool:

- A - To loosen
- B - To tighten

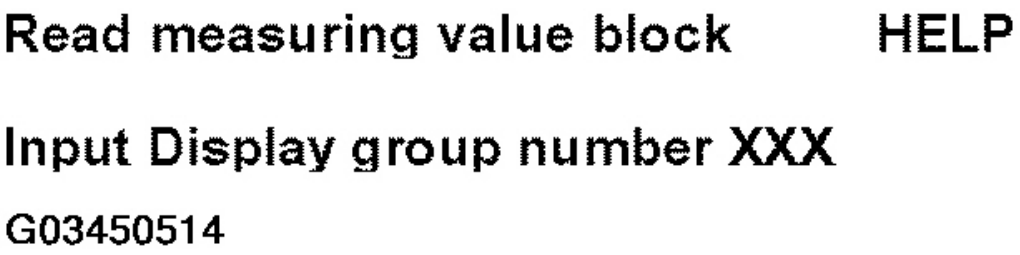

Fig. 47: Holding Drive Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Drive plate, installing

- Position drive plate and backing plate with recesses -1-.

- Install new bolts -3- and tighten.
  - 30 N.m (22 ft lb)

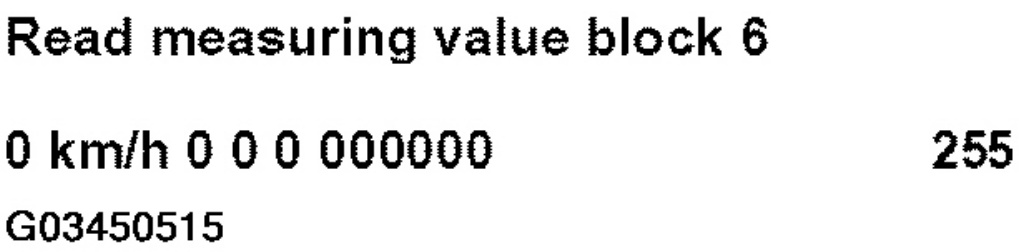

Fig. 48: Installing Drive Plate And Backing Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check dimension -a- at three points and calculate average.

  Specification: 19.5 to 21.1 mm

NOTE: **Because of the hole in the drive plate it is measured on the milled surface of the engine block**

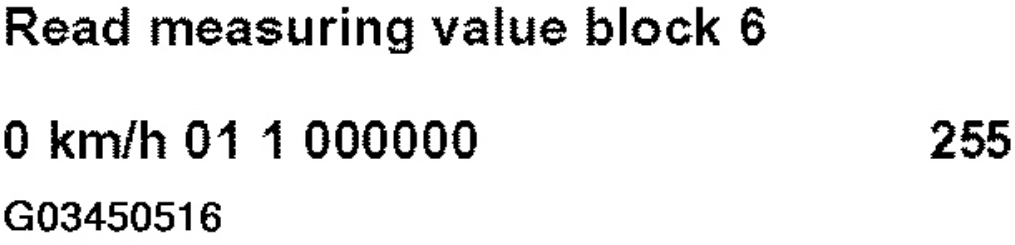

Fig. 49: Checking Drive Plate Installed Dimension
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If specification not obtained

- Remove drive plate and install shim -2-.

- Tighten bolts -3-.
  - 30 N.m (22 ft lb)
- Tighten bolts -3- to 60 N.m (44 ft lb) and turn an additional 90° (1 /4 turn) further.

NOTE: The 1/4 turn additional can be achieved in more than one step.

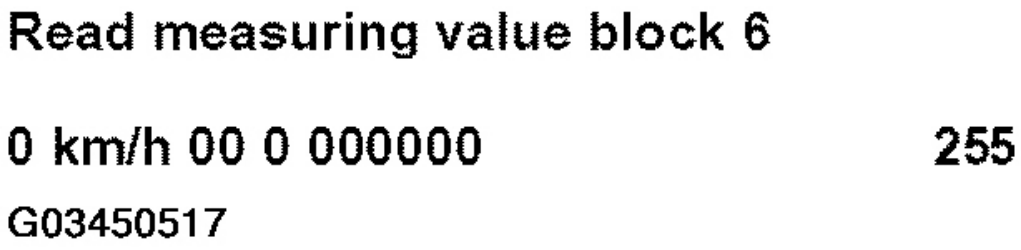

Fig. 50: Installing Drive Plate And Shim
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Sealing flange (front), removing and installing

Special tools and equipment

- 2080 A Sleeve
- 3415 Counter support
- VAG 1331 Torque wrench: 5 to 50 N.m (3.7 to 37 ft lb)
- VAG 1332 Torque wrench: 40 to 200 N.m (30 to 148 ft lb)
- Hand drill w/ plastic brush insert
- D 176 404 A2 Silicone sealant
- Flat scraper

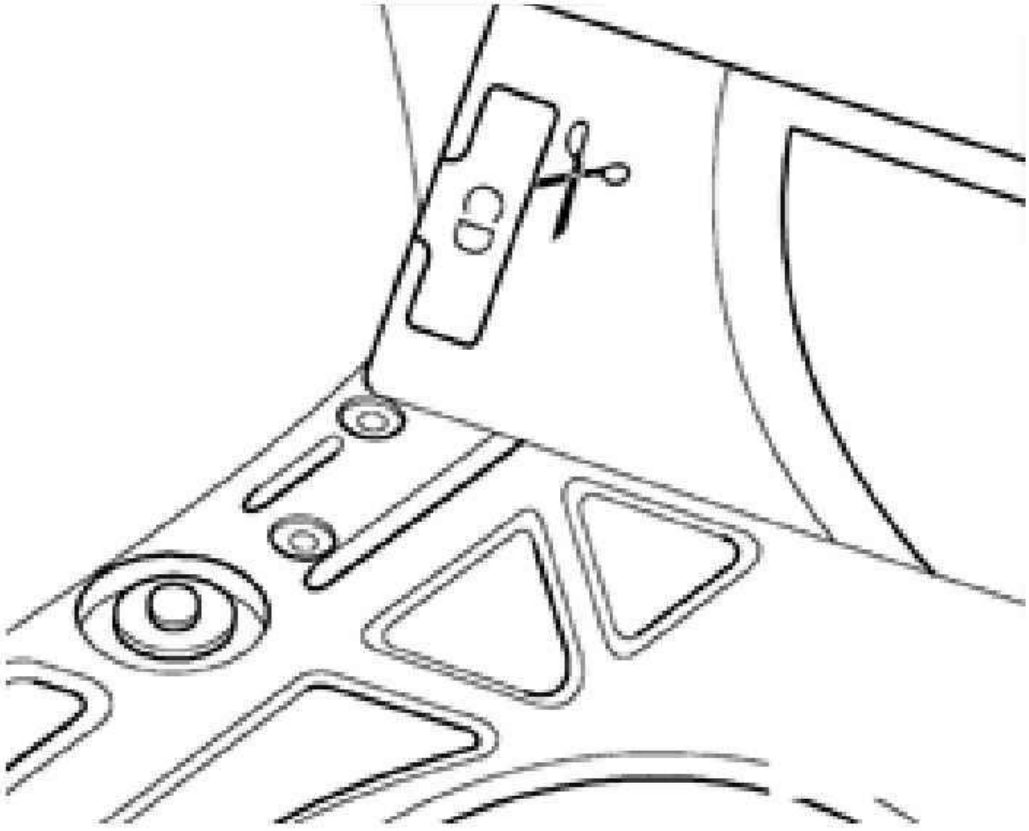

Fig. 51: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
- Remove toothed belt. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
- Remove crankshaft toothed belt sprocket by counter-holding sprocket with 3415.

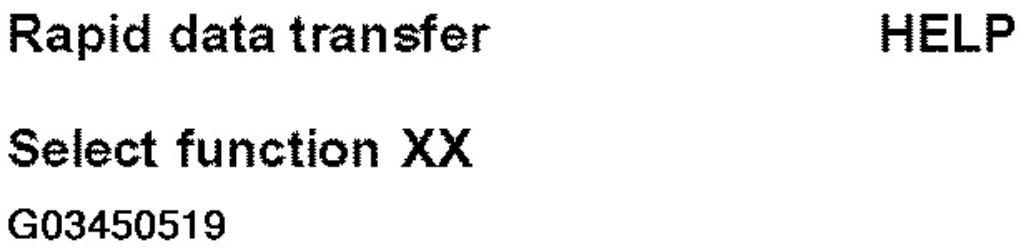

Fig. 52: Removing Crankshaft Toothed Belt Sprocket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Drain engine oil.
- Remove oil pan. See **OIL PAN, REMOVING AND INSTALLING**
- Unbolt front sealing flange.
- Remove sealing flange and if necessary, release using light blows with a rubber hammer.
- Remove sealant residue on engine block with a flat scraper.
- Remove sealant remains on sealing flange with a rotating plastic brush (wear protective goggles).

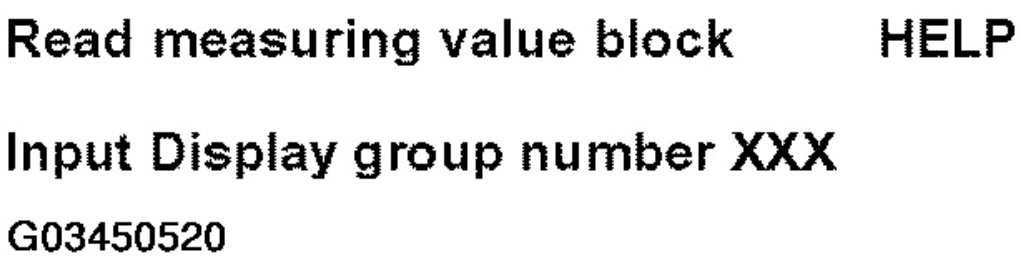

Fig. 53: Removing Sealant Remains On Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Clean sealing surface.

NOTE: Surface must be free of oil and grease

Installing

NOTE:

- **Observe the "must be used by" date on the sealant tube.**
- **Oil pan must be installed within 5 minutes after applying silicone sealing compound.**

- Cut off tube nozzle at forward mark (nozzle approx. 3 mm diameter)
- Apply silicone sealing compound, as shown, to a clean oil pan sealing surface.
  - Thickness of sealant bead must be (arrows): 2 to 3 mm

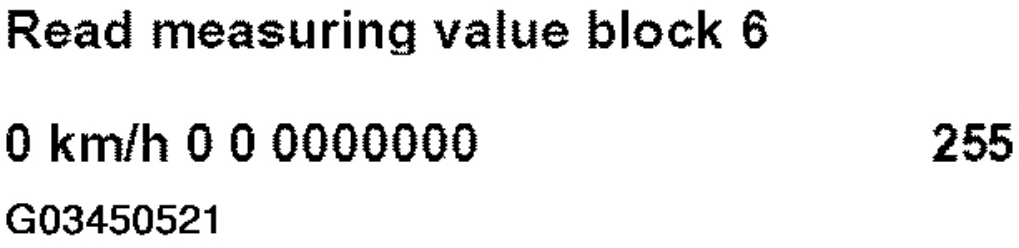

Fig. 54: Applying Silicone Sealant Bead To Clean Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

CAUTION: The sealing compound bead thickness specification must NOT be thicker, otherwise excess sealing compound will enter the oil pan and could block the oil suction pipe strainer.

- Apply silicone sealant bead as shown to the clean sealing surface of the sealing flange.
- Install sealing flange immediately, then lightly tighten all bolts.

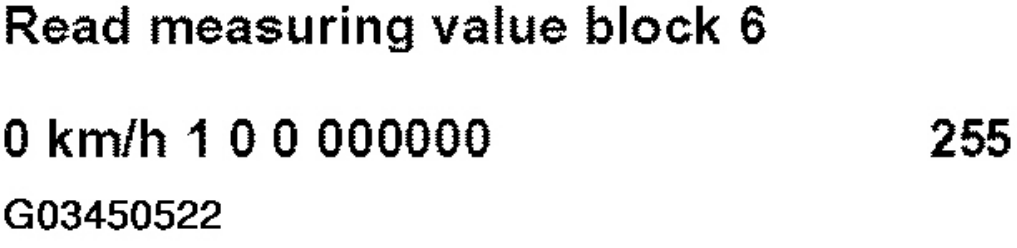

Fig. 55: Applying Silicone Sealant Bead To Clean Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Use guide sleeve from 2080A to install the sealing flange if the oil seal is already installed.

- Tighten sealing flange mounting bolts using a staggered tightening pattern.
  - Tightening torque: 15 N.m (11 ft lb)
- Install oil pan. See **OIL PAN, REMOVING AND INSTALLING**

NOTE: After installing; allow the sealant to dry for approx. 30 minutes before adding engine oil.

- Install toothed belt and adjust timing. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**

CRANKSHAFT, REMOVING AND INSTALLING

NOTE: The following list refers to items in Fig. 56 .

1. **Bearing shells:1, 2, 4 and 5**
   - For bearing caps without oil groove
   - For engine block with oil groove
   - Do NOT interchange used bearing shells (mark)
2. **65 N.m (48 ft lb) plus additional 1/4 turn (90°)**
   - Replace
   - Threaded along complete length of screw
   - To measure radial clearance tighten to 65 N.m (48 ft lb) but no further
3. **Bearing cap**
   - Bearing cap 1: Pulley end
   - Bearing cap 3 with recesses for thrust washers
   - Bearing shell retaining lugs engine block/bearing cap must be on the same side
4. **Bearing shell 3**
   - Bearing cap w/o oil groove
   - For engine block with oil groove
5. **Thrust washer**
   - For bearing cap 3
   - Note fixing arrangement
6. **Sensor wheel**

- For Engine Speed sensor

7. **10 N.m (7 ft lb) plus additional 1/4 turn (90°)**
   - Always replace
8. **Fitted pin**
   - Checking projection from crankshaft. See **Crankshaft dowel pin projection, checking**
9. **Crankshaft**
   - Axial clearance new: 0.07 to 0.17 mm Wear limit: 0.37 mm
   - Check radial clearance with Plastigage New: 0.03 to 0.08 mm Wear limit: 0.17 mm
   - Do not rotate crankshaft when checking radial clearance
   - Crankshaft dimensions. See **CRANKSHAFT DIMENSIONS (MM)**
10. **Thrust washer**
11. For engine block, bearing 3

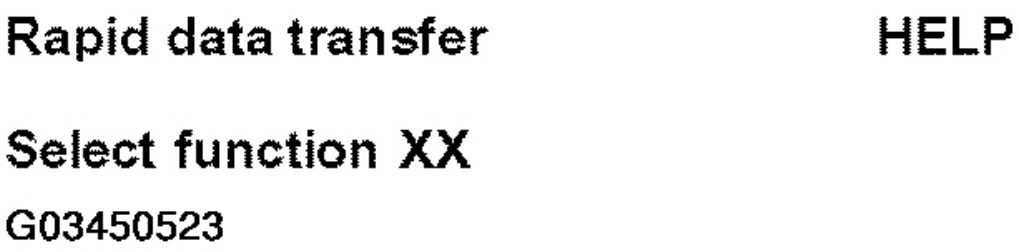

Fig. 56: Exploded View Of Crankshaft & Main Bearing Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Crankshaft dowel pin projection, checking

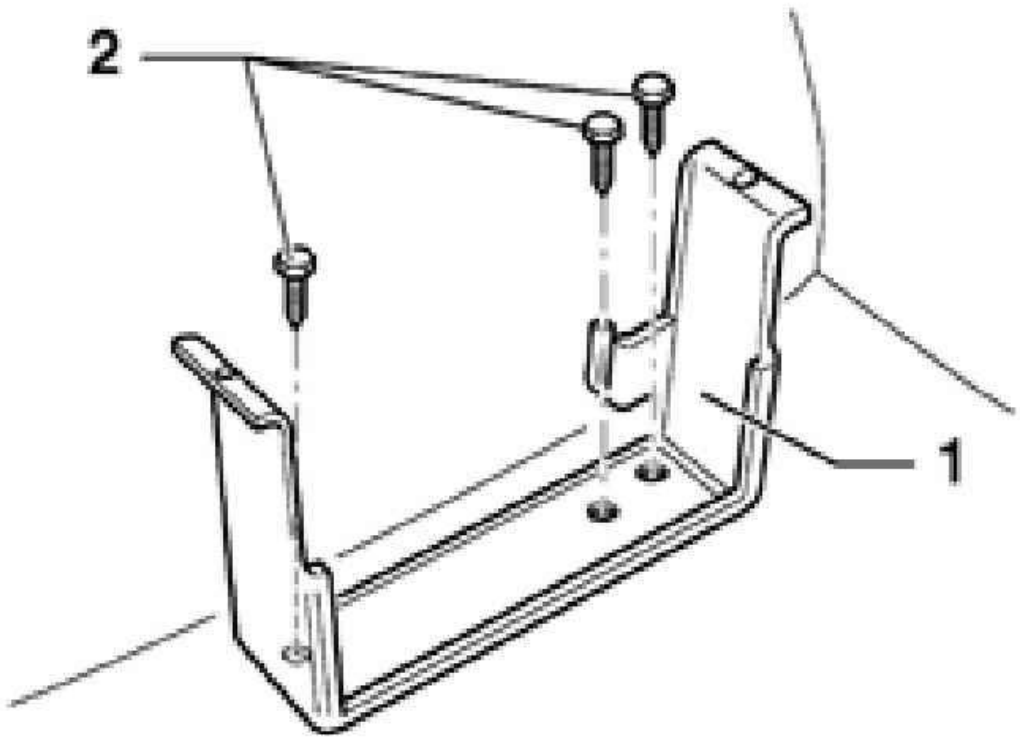

Fig. 57: Checking Crankshaft Dowel Pin Projection
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Dowel pin projection -3- out of crankshaft a = 2.5 to 3.0 mm

Crankshaft dimensions (mm)

CRANKSHAFT DIMENSIONS CHART

Honing dimension	Main journal diameter	Con-rod journal diameter
Basic dimension	-0.022 54.00 -0.042	-0.022 47.80 -0.042
1st undersize	-0.022 53.75 -0.042	-0.022 47.55 -0.042
2nd undersize	-0.022 53.50	-0.022 47.30

	-0.042	-0.042
3rd undersize	-0.022 53.25 -0.042	-0.022 47.05 -0.042

PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING

NOTE: The following list refers to items in Fig. 58 .

1. **Piston ring**
   - Offset ring gaps 120°
   - Remove and install using piston ring pliers
   - "TOP" faces towards crown
   - Ring gap, checking: See **Piston ring gap, checking**
   - Ring to groove clearance. See **Ring to groove clearance, checking**
2. **Piston**
   - Mark installation position and cylinder number
   - Arrow on piston crown points to: pulley end
   - Install using piston ring tool
   - If any cracks on piston skirt, replace piston
   - Piston projection at TDC, checking. See **PISTON PROJECTION AT TDC, CHECKING**
3. **Piston pin**
   - If difficult to remove, heat piston to 60 °C
   - Remove and install using VW 222A
4. **Circlip**
5. **Connecting rod**
   - Only replace as a set
   - Mark cylinder number -A-
   - Installed position: Marking -B- faces pulley end
6. **Fitted pin**
   - Pin must seat securely in connecting rod, not in bearing cap
7. **Bearing shell**
   - Note installed position
   - Do not interchange used bearing shells
   - Make sure retaining lugs fit tightly in recesses
   - Axial clearance Wear limit: 0.37 mm
   - Check radial clearance with Plastigage: Wear limit: 0.08 mm Do not rotate crankshaft while checking.
8. **Cylinder block**

- Checking cylinder bores. See **Cylinder bores, checking**
- Piston and cylinder dimensions: See **PISTON AND CYLINDER DIMENSIONS IN MM**

9. **Connecting rod bearing cap**
    - Note installed position
10. **Oil spray jet**
    - For piston cooling
11. **25 N.m (18 ft lb)**
    - Install without sealant
12. **Connecting rod bolt**
    - 30 N.m (22 ft lb) plus additional 1/4 turn (90°)
    - Always replace
    - Oil the threads and contact surfaces
    - Use old bolts to measure radial clearance

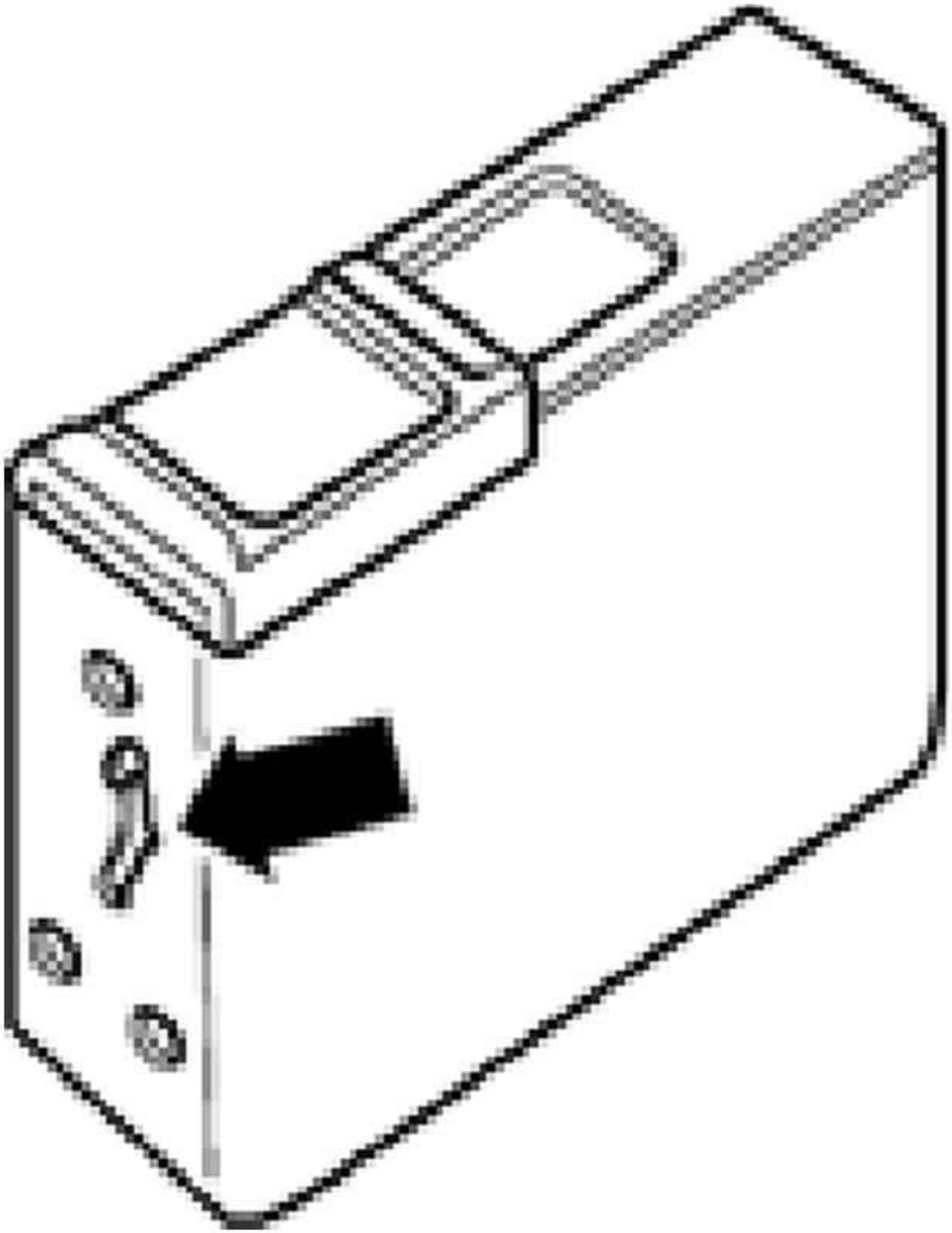

Fig. 58: Disassembling And Assembling Pistons And Connecting Rods
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Piston ring gap, checking

- Squarely insert ring into top of cylinder and push it down to approx. 15 mm from lower edge of cylinder.

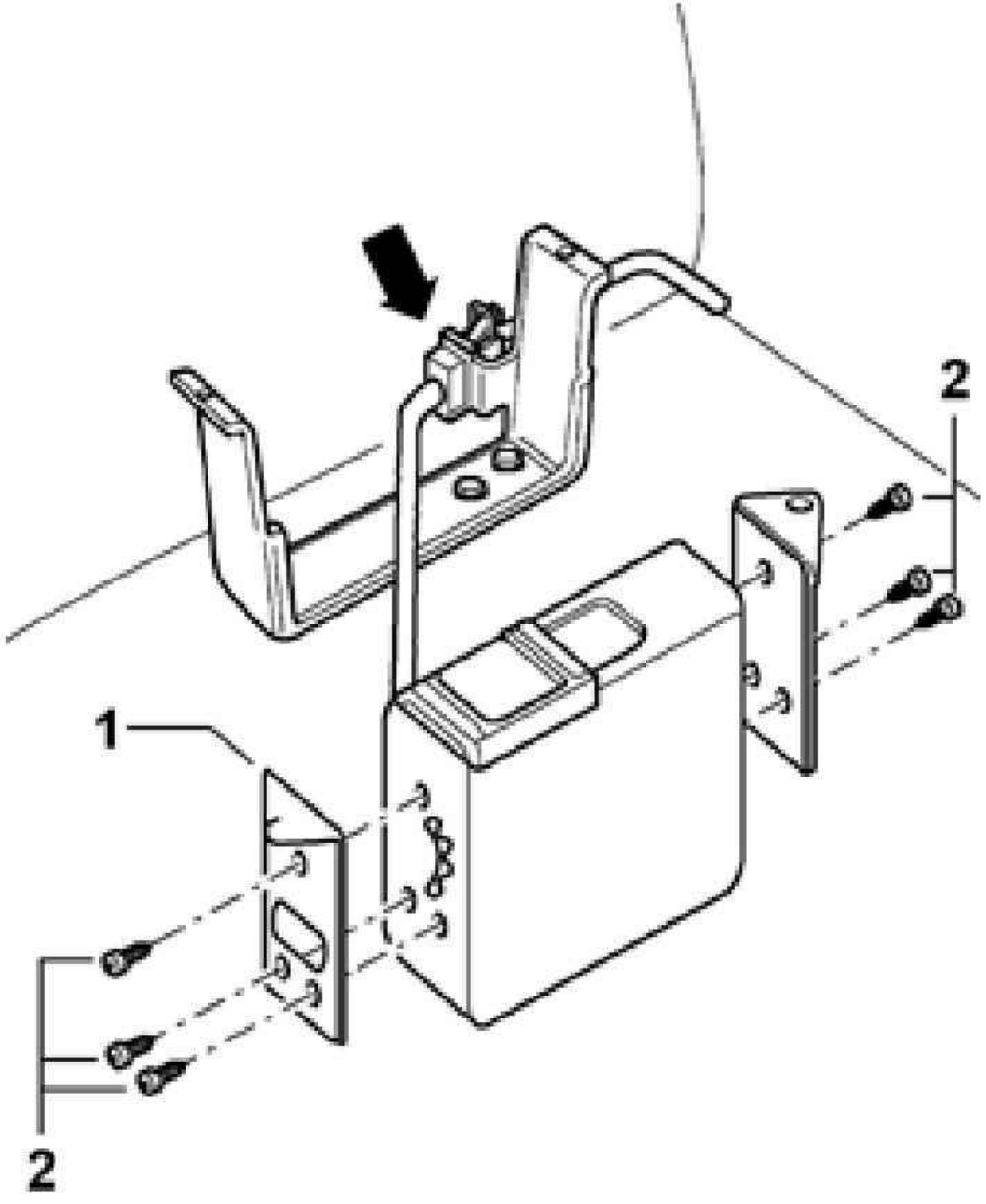

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Fig. 59: Checking Piston Ring Gap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

PISTON RING END GAP DIMENSIONS

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.20 to 0.40	1.0
2nd compression ring	0.20 to 0.40	1.0
Oil scraper ring	0.25 to 0.50	1.0

Ring to groove clearance, checking

Clean groove before checking.

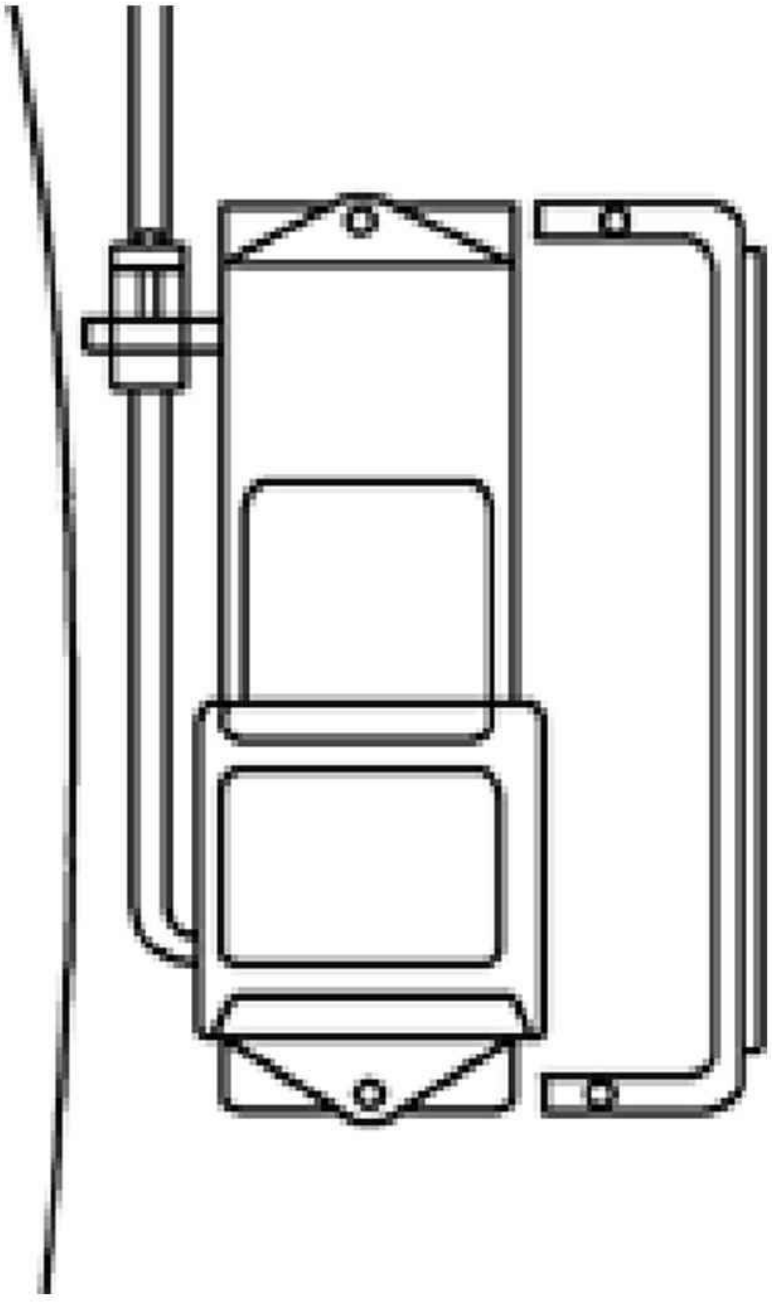

Fig. 60: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

RING TO GROOVE CLEARANCE DIMENSIONS

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.06 to 0.09	0.25
2nd compression ring	0.05 to 0.08	0.25
Oil scraper ring	0.03 to 0.06	0.15

Cylinder bores, checking

Special tools and equipment

- Internal dial gauge 50 to 100 mm
- Take measurements at 3 positions in both lateral -A- and longitudinal -B- directions, as illustrated.
  - Deviation from nominal dimension: 0.10 mm maximum

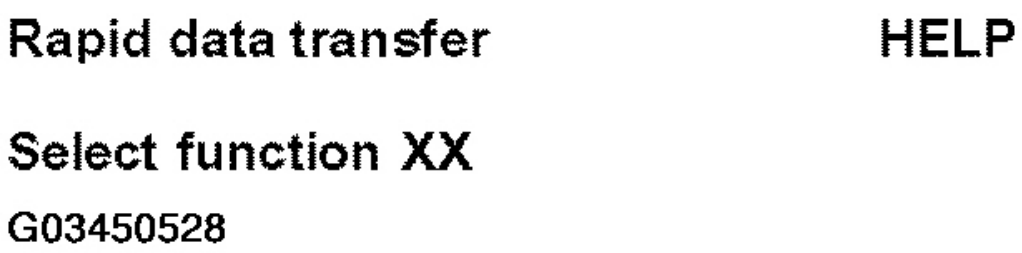

Fig. 61: Checking Cylinder Bores
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Do NOT measure the cylinder bores when the block is mounted on a repair stand using the VW 540 adaptor bracket. Bending stresses resulting from the mass overhang will make incorrect measurements likely.

Piston installation position and piston/cylinder allocation

Piston in cylinders 1 and 2:

Larger intake valve chamber points toward flywheel (arrows)

Piston in cylinders 3 and 4:

Larger intake valve chamber points toward belt pulley side (arrows).

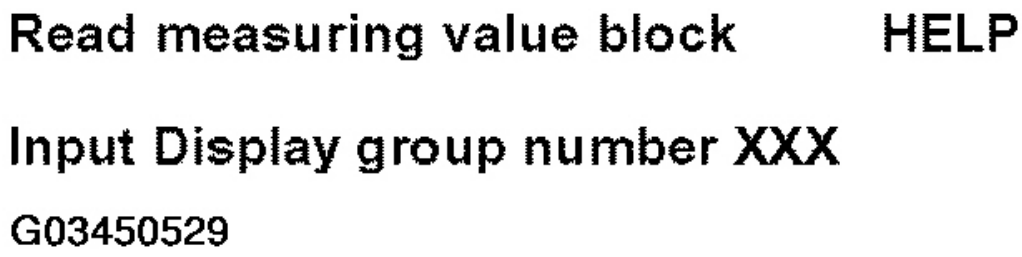

Fig. 62: Identifying Piston Installation Position
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: New piston/cylinder allocations are shown by a colored mark on the piston crown.

- Piston for cylinder 1 and 2: marked 1/2
- Piston for cylinder 3 and 4: marked 3/4

Piston projection at TDC, checking

Special tools and equipment

- VW 382/7

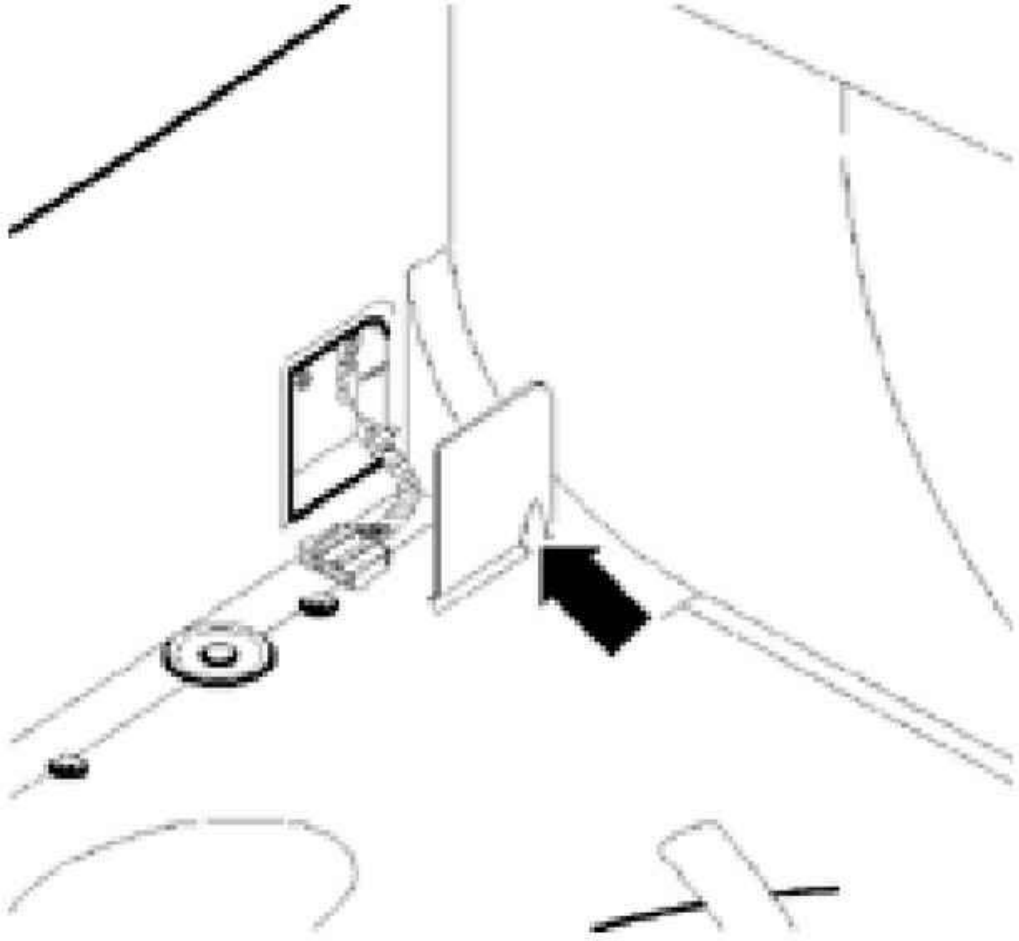

Fig. 63: Identifying VW 382/7
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VW 385/17

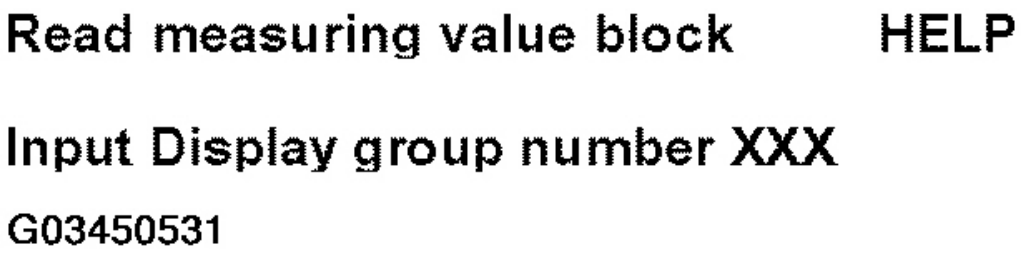

Fig. 64: Identifying VW 385/17
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Test sequence

Piston projection at TDC must be measured when installing new pistons or a short block. Depending upon piston projection, install the corresponding cylinder head gasket using the following table:

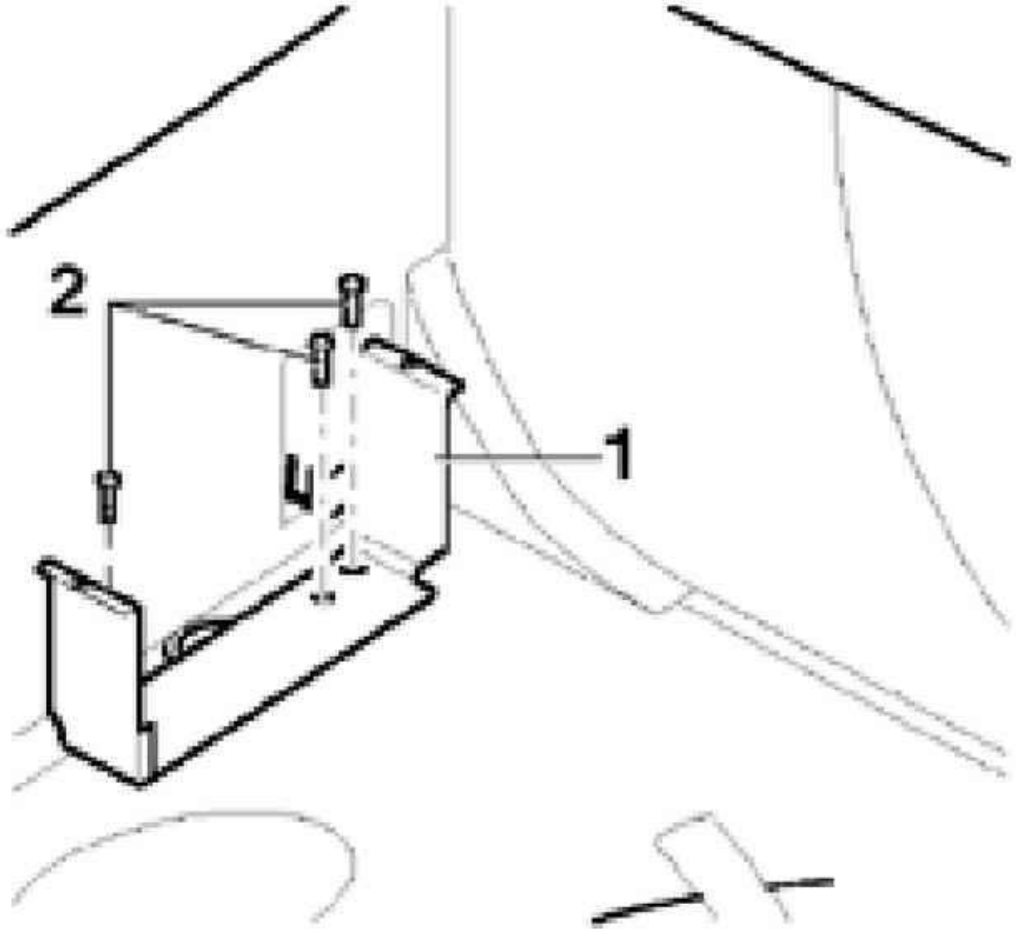

Fig. 65: Measuring Piston Projection At TDC
Courtesy of VOLKSWAGEN OF AMERICA, INC.

PISTON PROJECTION IDENTIFICATION

Piston projection	Identification: holes / notches
0.91 mm to 1.00 mm	1
1.01 mm to 1.10 mm	2
1.11 mm to 1.20 mm	3

Cylinder head gasket, identification

- Part No. = arrow -1-
- Production control code = arrow -2- (can be disregarded)
- Holes = arrow -3-

NOTE: **If different values are obtained from the piston projection measurements, use the largest measurement to select the proper gasket.**

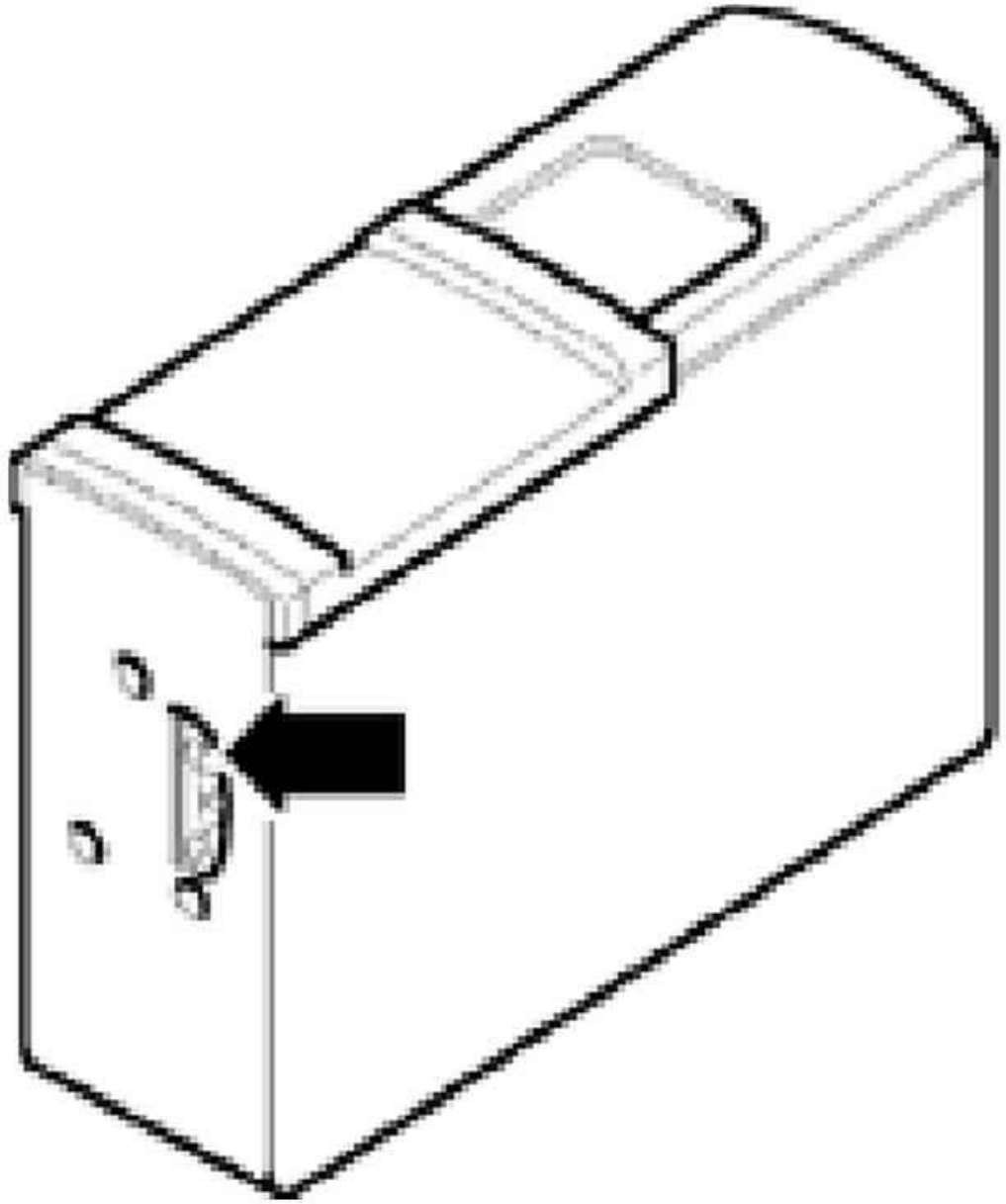

Fig. 66: Identifying Cylinder Head Gasket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Piston and cylinder dimensions in mm

PISTON AND CYLINDER DIMENSIONS

Honing dimension	Piston diameter	Cylinder bore diameter
Basic dimen., mm	79.47	79.51
1st oversize, mm	79.72	79.76
2nd oversize, mm	79.97	80.01

ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD, REMOVING AND INSTALLING

Compression checking **COMPRESSION PRESSURE, CHECKING**

NOTE:

- **When installing an exchange cylinder head (complete with installed camshafts): Oil the contact surfaces between the lifters and the cam lobes before installing the valve cover.**
- **Do NOT remove the plastic packing pieces which protect the open valves until immediately before installing the cylinder head.**
- **If the cylinder head is replaced:**
  - **Replace the entire engine coolant.**

NOTE: The following list refers to items in Fig. 67 .

1. **Toothed belt guard, upper section**
2. **Toothed belt**
   - Mark direction of engine rotation before removing
   - Check for wear
   - Do not kink
   - Removing and installing. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
3. **20 N.m (15 ft lb)**
4. **20 N.m (15 ft lb)**
5. **45 N.m (33 ft lb)**
6. **Camshaft sprocket**
   - Drive off of camshaft taper using hammer and drift through toothed belt guard openings
7. **Tensioning roller (semiautomatic, toothed belt)**
   - Checking: See **SEMI-AUTOMATIC TOOTHED BELT TENSIONING ROLLER, CHECKING**
8. **Idler roller**
9. **Toothed belt guard, rear**
10. **10 N.m (7 ft lb)**

11. **Lifting eye**
12. **Cylinder head bolt**
    - Replace
    - Note sequence when loosening and tightening. See **CYLINDER HEAD, REMOVING AND INSTALLING**
13. **Oil deflector**
14. **Valve cover**
    - With vulcanized seal
    - Replace complete if damaged or leaking

CAUTION: The valve cover seal is an integral part of the valve cover. Replace the valve cover only if it is damaged or leaking.

15. **Seal**
    - Replace if damaged
16. **Cap**
    - Replace seal if damaged
17. **Breather pipe**
18. **Retaining clip**
19. **Pressure regulating valve**
    - For Positive Crankcase Ventilation valve
20. **Gasket**
    - Replace if damaged
21. **5 N.m (44 in. lb)**
22. **Fuel injector lines**
    - 25 N.m (18 ft lb)
    - Remove using 3035 offset tubing wrench
    - Always remove fuel line cluster as an assembly
    - Do not bend, kink or alter shape
23. **Exhauster**
    - For brake booster
24. **Gasket**
    - Always replace
25. **Fuel injector**
    - Removing and installing:

See **FUEL INJECTORS, REMOVING AND INSTALLING**

26. **Glow plug**
    - 15 N.m (11 ft lb)
    - Checking:

    See **GLOW PLUGS -Q6-, CHECKING**

27. **Cylinder head gasket**
    - Replace
    - Note marking. See **Cylinder head gasket, identification**
    - If replaced; also replace entire engine coolant

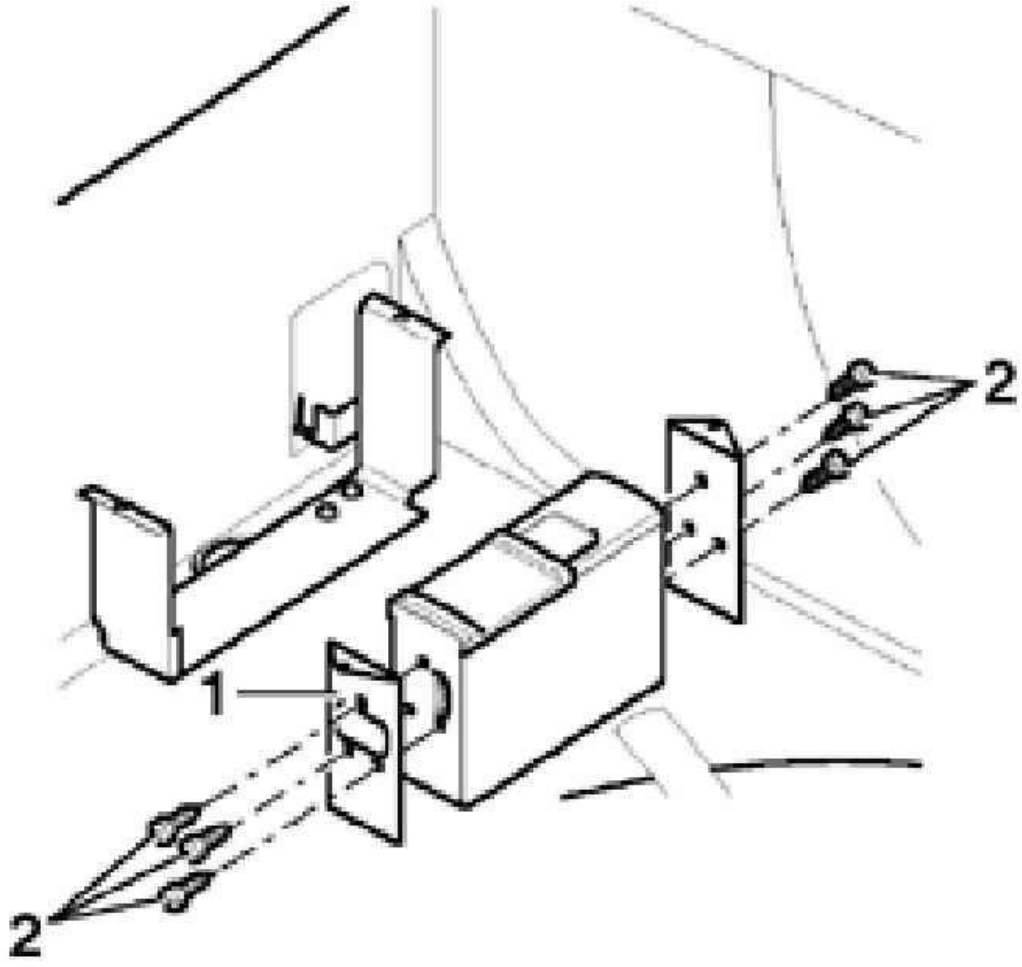

Fig. 67: Exploded View Of Cylinder Head Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Cylinder head distortion, checking

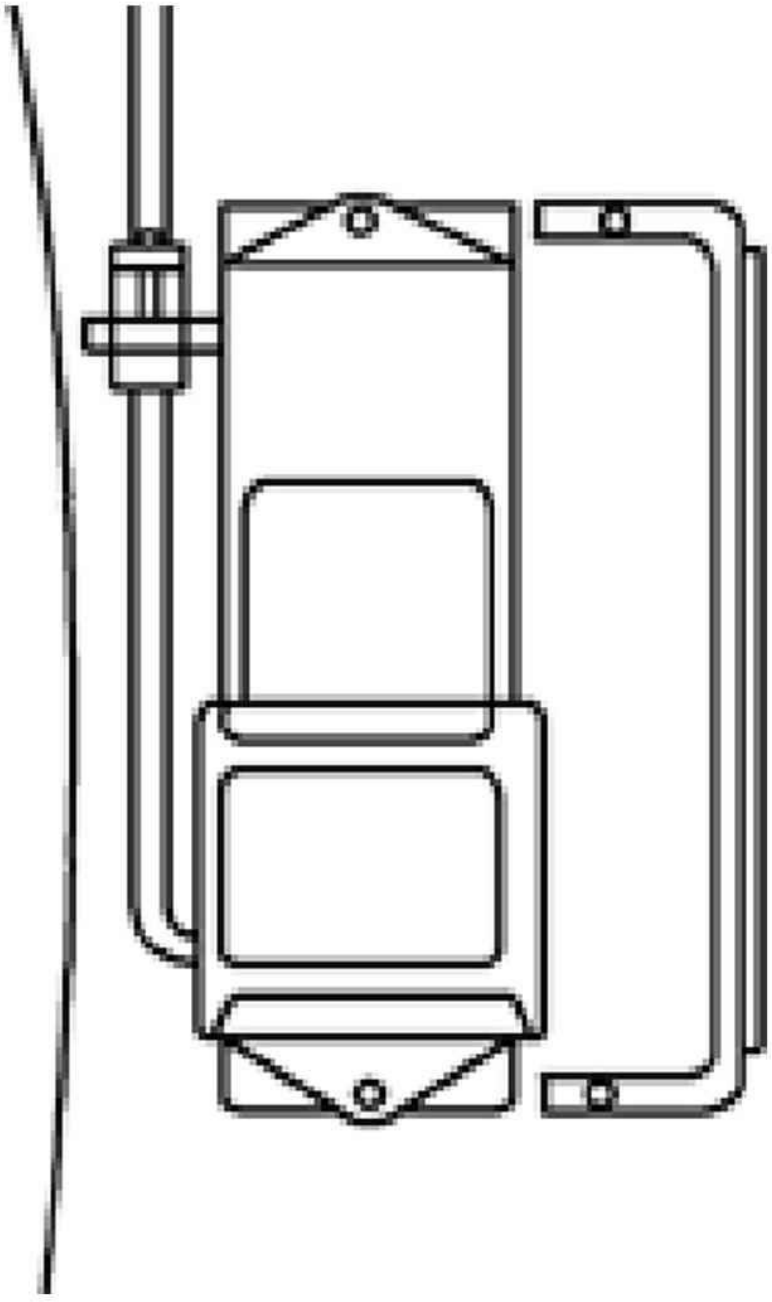

Fig. 68: Checking Cylinder Head Distortion
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Max. permissible distortion: 0.1 mm

NOTE: Reworking Diesel cylinder heads is not permissible.

Cylinder head gasket, identification

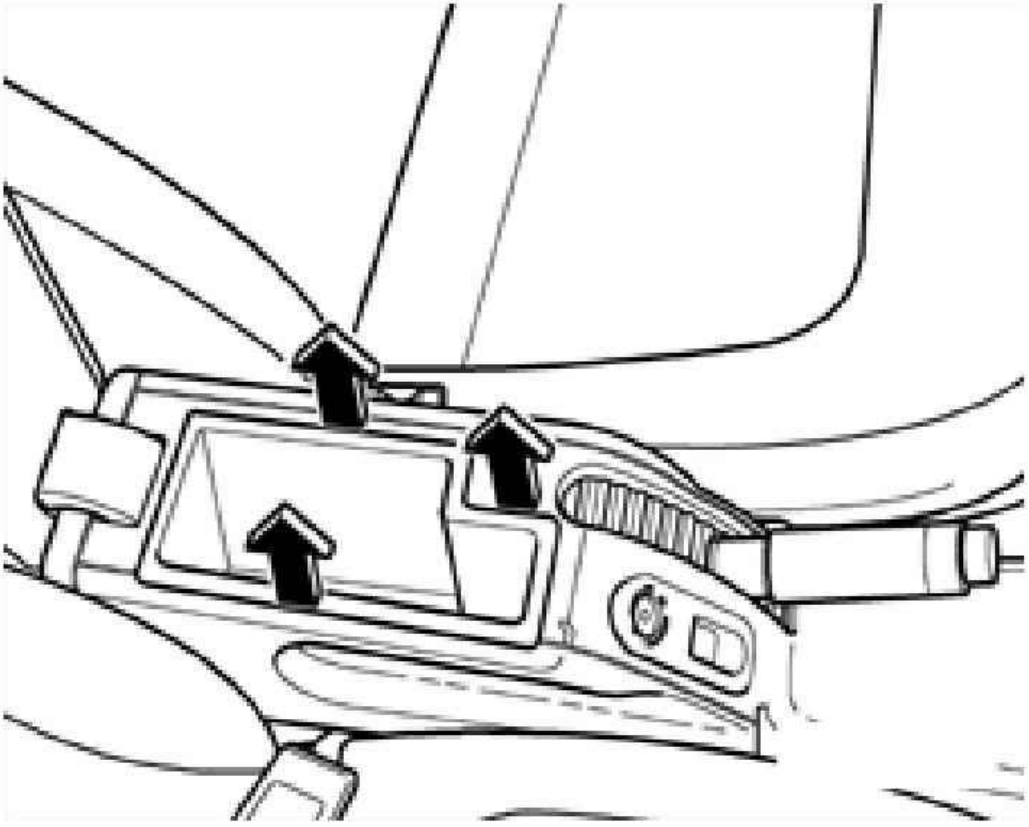

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Fig. 69: Identifying Cylinder Head Gasket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Part No. = arrow -1-
- Production control code = arrow -2- (ignore)
- Holes = arrow -3-

NOTE: Different thicknesses of cylinder head gasket are installed depending on the piston projection dimension. When replacing the cylinder head gasket, install a new gasket with the same identification.

Cylinder head, removing and installing

Special tools and equipment

- 10-222A Engine support bridge
- 10-222 A/8 Adaptor
- 3035 Injector line wrench
- 3070 Guide pins & handle-1112 mm
- T 10014 Engine support
- VAG 1306 Drip tray for VAG 1202A

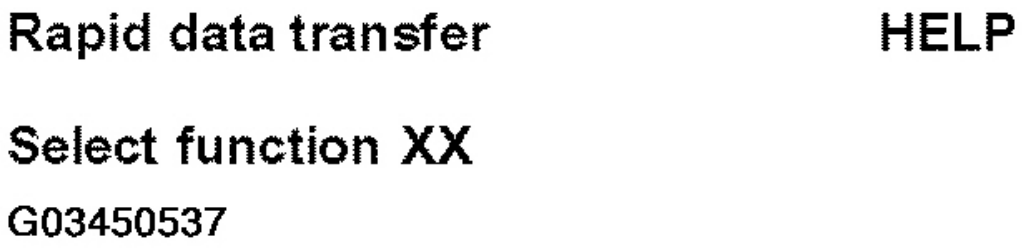


Fig. 70: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG 1331 Torque wrench: 5 to 50 N.m (3.7 to 37 ft lb)
- VAG 1332 Torque wrench: 40 to 200 N.m(30to148ftlb)
- VAG 1921 Hose clip pliers

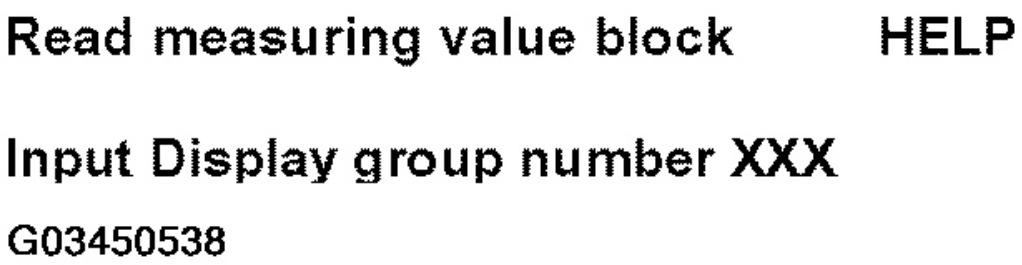


Fig. 71: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirements

- Engine must NOT be more than warm to the touch.
- Pistons must NOT be positioned at TDC.

Removing

CAUTION: Obtain radio anti-theft code from customer before disconnecting battery ground strap.

- With ignition switched OFF, disconnect battery Ground strap.
- Remove engine cover.
- Remove Air Cleaner.
- Remove connecting pipe between Charge Air cooler and intake manifold/EGR Vacuum Regulator Solenoid valve.
- Remove sound dampening tray:

  See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Drain engine coolant. See **COOLING SYSTEM, DRAINING AND FILLING**
- Disconnect fuel supply and return lines at fuel filter.

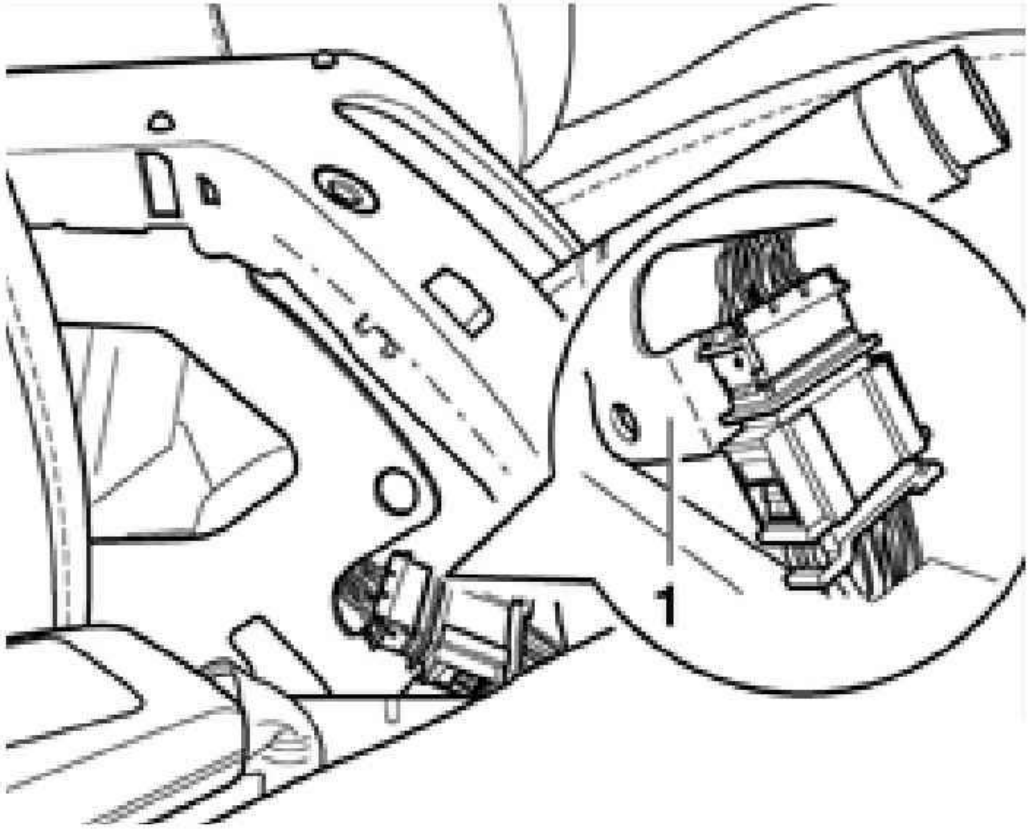


Fig. 72: Disconnecting Fuel Supply And Return Lines
Courtesy of VOLKSWAGEN OF AMERICA, INC.

WARNING: Fire hazard! Do NOT have anything in the area that can ignite Diesel fuel!

- Seal lines so fuel system is not contaminated by dirt etc.
- Remove front exhaust pipe. See **FRONT EXHAUST PIPE AND CATALYST WITH ATTACHMENTS**
- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
- Unscrew wiper arms.
  - M8 hex nuts = 20 N.m (15 ft lb)
- Remove plenum chamber cover.

See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Disconnect fuel supply and return lines at fuel filter.
- Remove fuel filter with bracket
- Disconnect all coolant, vacuum and breather hoses from engine.
- Disconnect all wiring connections from transmission, Generator and starter and move to one side.
- Loosely unscrew coolant reservoir and place to side.
- Remove toothed belt guard upper section.
- Remove valve cover.
- Remove brake booster vacuum pump.
- Unscrew turbocharger oil return line to cylinder block.
- Unscrew oil supply line at turbocharger
- Remove injection lines.

NOTE: Always remove injection lines as a set. Use 3035 offset tubing wrench to loosen/tighten the injection lines.

- Remove return line from injector jets/injection pump.
- Remove glowplug harness connector.
- Install engine support bracket 10-222A with 10-222 A/1 legs.

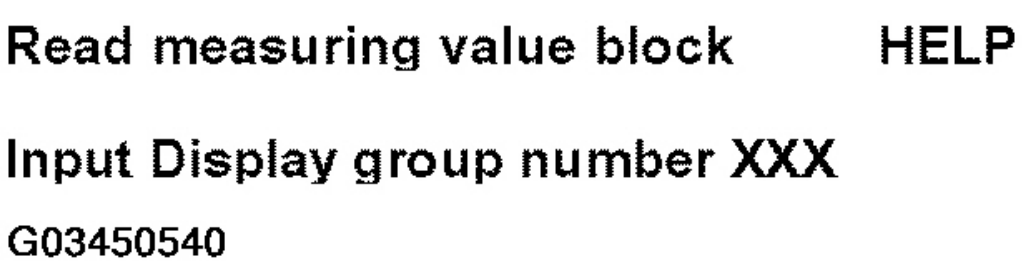


Fig. 73: Installing Engine Support Bracket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosely unscrew subassembly (engine side) from upper engine bracket (arrows).
- Remove engine mount and engine bracket.
- Lift engine again slightly using spindle -B-.

NOTE: Both lifting eyes are located on the cylinder head, therefore an additional

bracket must be attached to the block to support the engine.

- Attach T 10014 bracket to cylinder block using threaded hole in water pump area (as illustrated).

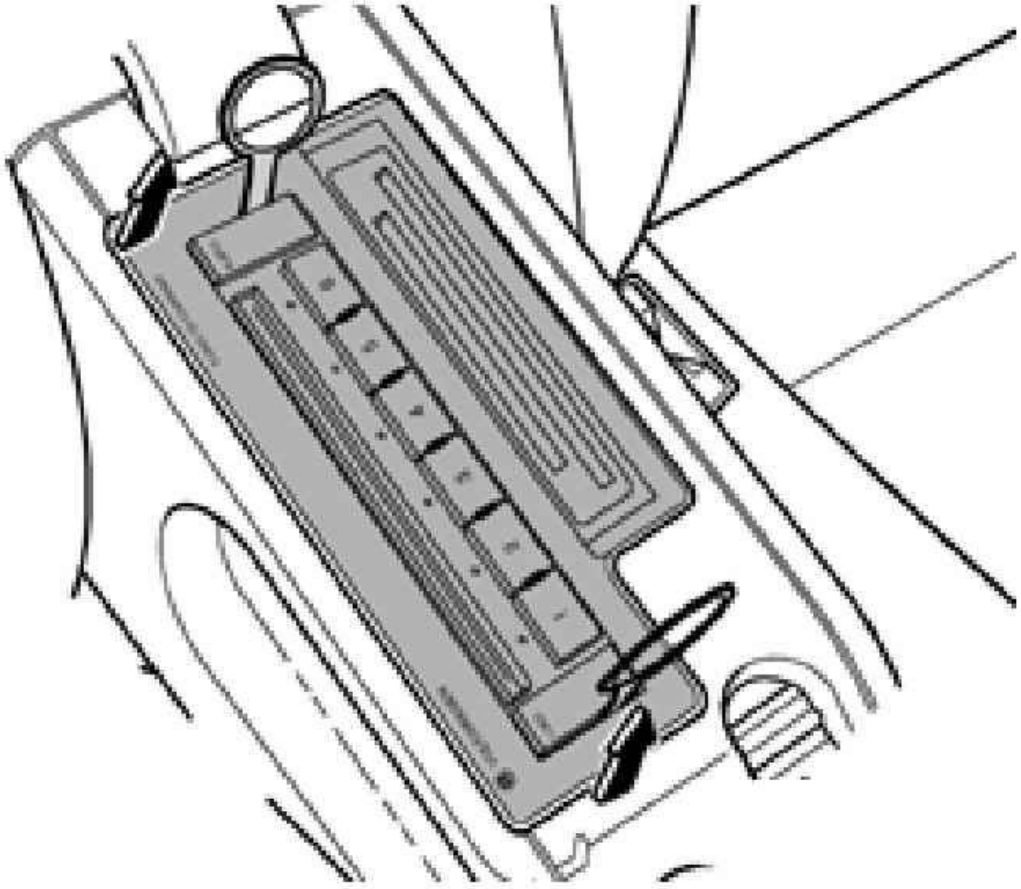
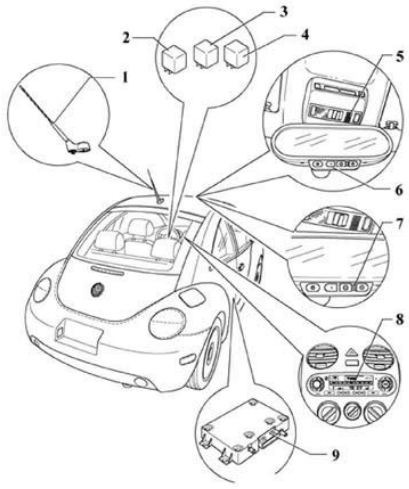


Fig. 74: Attaching T 10014 Bracket To Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lift engine slightly using second spindle -A- until spindle -B- is relieved.
- Remove spindle -B-.
- Position engine at TDC with camshaft sprocket loosened and toothed belt removed from camshaft sprocket. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
- Remove tension roller and camshaft sprocket.

- Unscrew upper bolt of belt guard, rear.
- Loosen socket head bolts in sequence given, then remove bolts completely.



1 - Antenna -R11-, Antenna Amplifier - R24- and Antenna for Navigation System (GPS) -R50-

- On roof, rear
- Removing and installing

2 - Dual Horn Auxiliary Relay -J733-

- On 13-position auxiliary relay panel, above relay panel.

3 - Auxiliary Emergency Flasher Relay -J517-

- On 13-position auxiliary relay panel, above relay panel.

4 - Warning Lamp Auxiliary Relay - J734-

- On 13-position auxiliary relay panel, above relay panel.

5 - Telephone Microphone -R38-

- Integrated with front interior light module.
- Removing and installing

6 - Telematic Control Head -E264-

- Integrated with rear view mirror.
- OnStar® buttons, description
- Includes telematics indicator lamp -7-.
- Removing and installing

7 - Telematics Indicator Lamp -K186-

- In Telematic Control Head.
- LED indicates telematic system operational status. Description
- Telematic system, troubleshooting using telematics indicator lamp

8 - Radio -R-

- In center console.

9 - Telematic Control Module -J499-

- Installed behind right rear side panel trim under rear speaker.
- Removing and installing
- Control module multi-pin connector terminal assignments

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Fig. 75: Loosening Head Bolts In Sequence

Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully lift off cylinder head.

Installing

NOTE:

- **Always replace cylinder head bolts.**
- **Make sure that there isn't any oil or coolant in the cylinder head bolt hollows (in the cylinder head).**
- **Only remove the new cylinder head gasket from its packing immediately before installing.**
- **When repairing, carefully remove any gasket remains from the cylinder head and cylinder block. Ensure that no long grooves or scratches are created. When using abrasive paper do not use a grade coarser than 100 (e.g. 80).**
- **Carefully remove any emery or abrasive remains.**
- **Handle the new gasket with extreme care. Damaging will lead to leaks.**

- Turn crankshaft to TDC mark before installing cylinder head.
- Turn crankshaft against engine direction of rotation until all pistons are approximately equally spaced below TDC.
- To centralize: screw guide pins from 3070/9 into outer threaded holes on intake side.

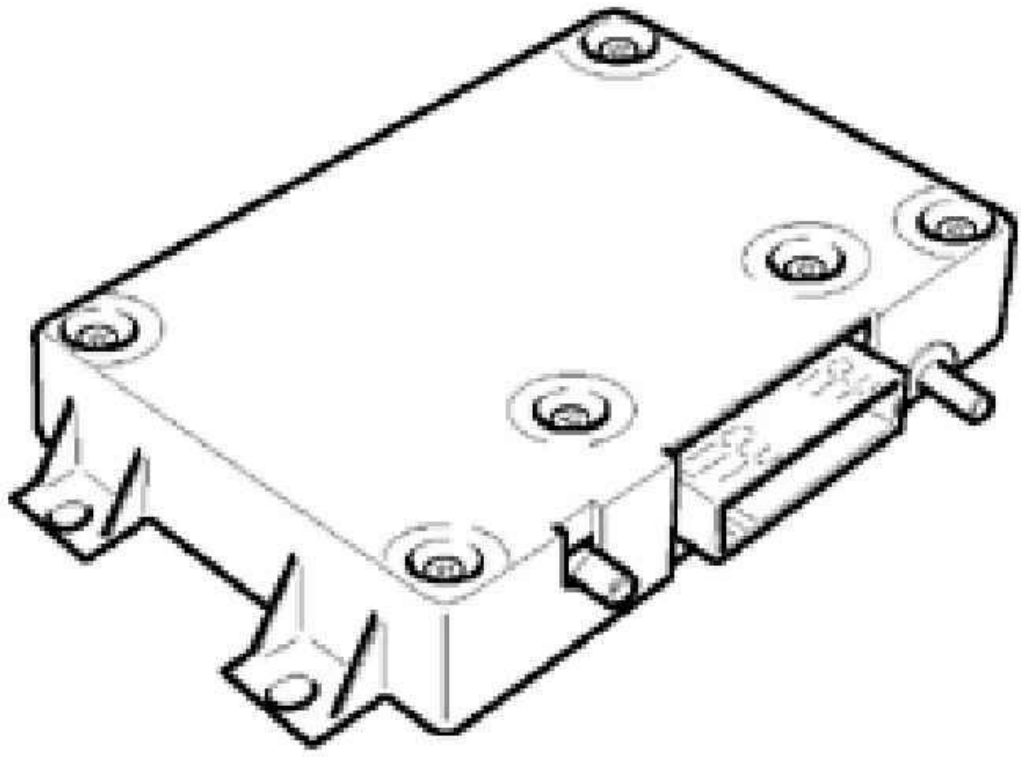

Fig. 76: Identifying Screw Guide Pins
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install new cylinder head gasket.
  - Lettering (Part No.) must be readable.
- Install cylinder head, screw in 8 remaining head bolts and tighten by hand.
- Remove guide pins with removal tool from 3070 by turning removal tool counter-clockwise until pins are free
- Install remaining cylinder head bolts and tighten hand-tight.
- Tighten cylinder head in following four stage sequence:
- Tighten initially using torque wrench:

Stage I = 40 N.m (30 ft lb)

Stage II = 60 N.m (44 ft lb)

- Turn further with a normal wrench:

  Stage III 1/4 turn (90°)

  Stage IV 1/4 turn (90°)

Assembly is basically a reverse of the disassembly sequence.

- Installing toothed belt and timing adjustment. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
- Coolant, filling. See **COOLING SYSTEM, DRAINING AND FILLING**

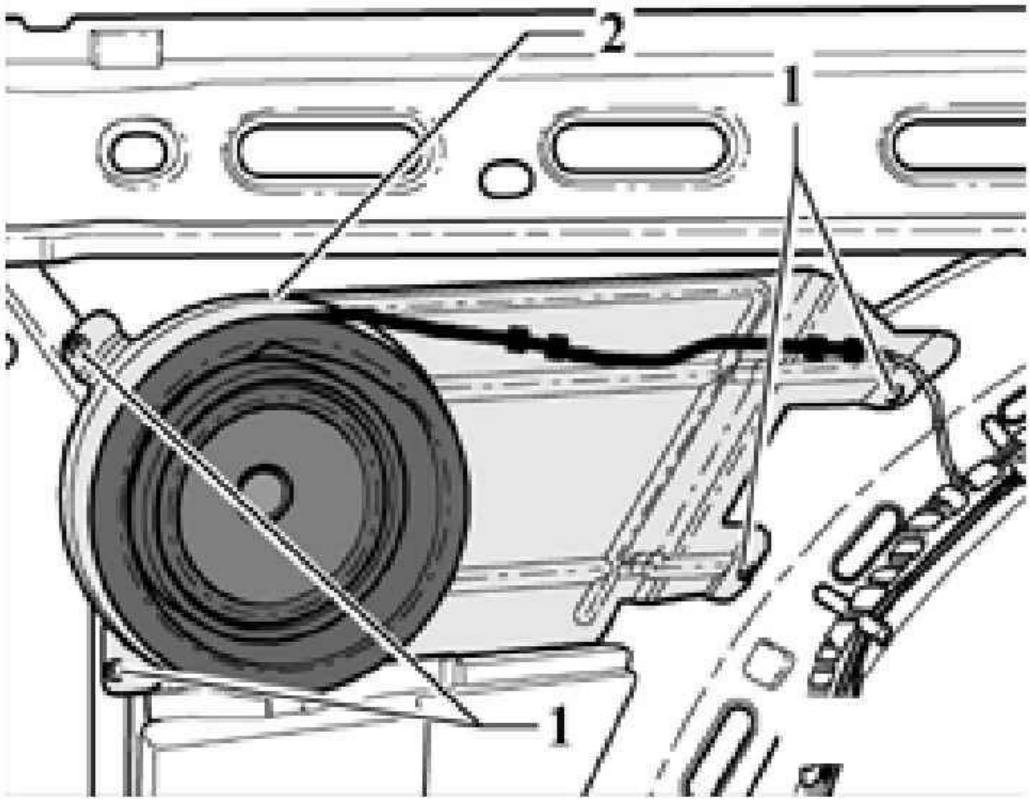

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Fig. 77: Tightening Cylinder Head Bolts In Sequence
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Compression pressure, checking

Special tools and equipment

- 3220 Hinged socket
- VAG 1331 Torque wrench: 5 to 50 N.m (3.7 to 37 ft lb)
- VAG 1381/12 Adaptor
- VAG 1763 Compression tester

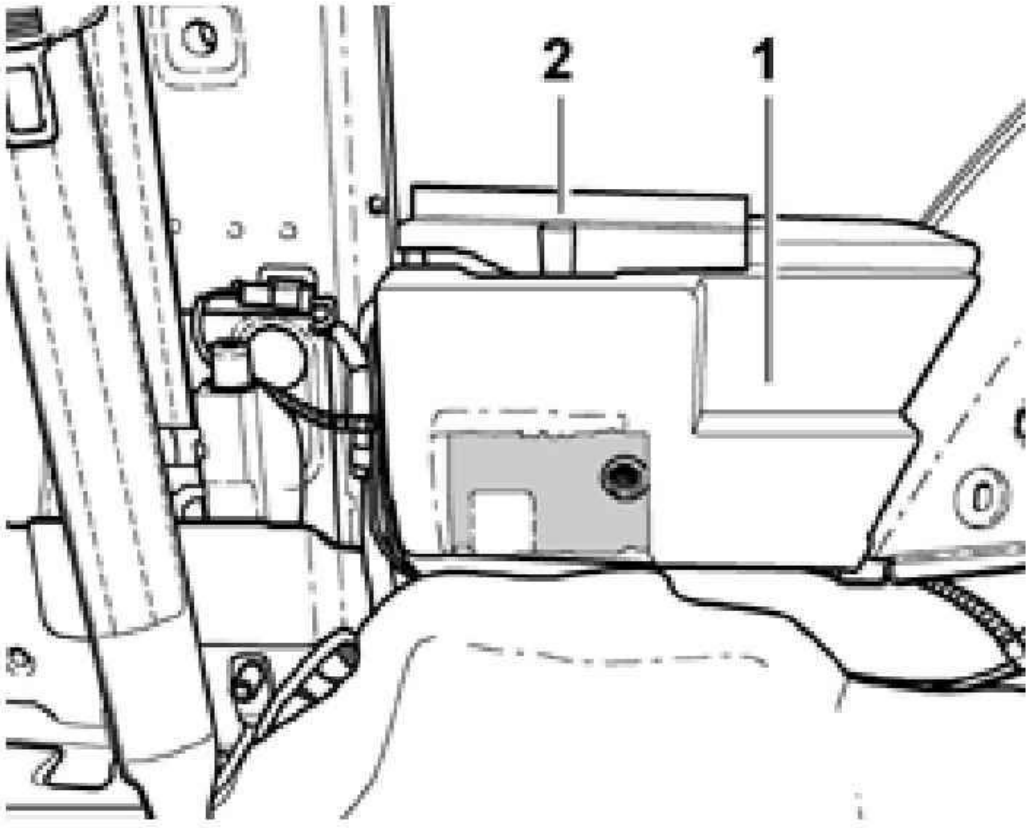


Fig. 78: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirement

- Engine oil temperature must be 30°C minimum.

Test sequence

- Disconnect fuel cut-off valve on Diesel injection pump.
- Disconnect Quantity adjuster harness connector on Diesel injection pump.
- Remove all glow plugs using 3220 flexible wrench.
- Screw in VAG 1381/12 adaptor in place of glow plugs.

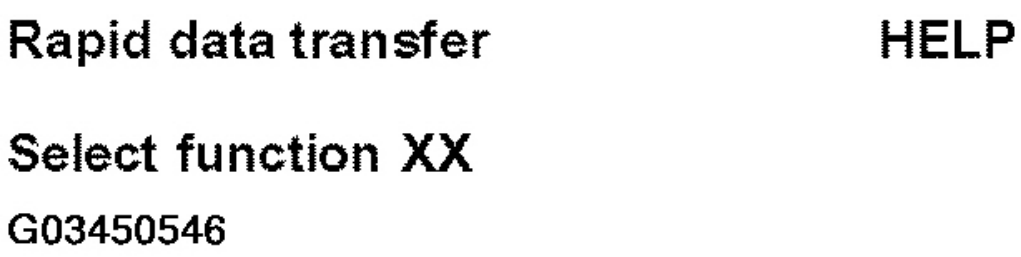


Fig. 79: Checking Compression With Compression Tester
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check compression using VAG 1763 compression tester.
- Operate starter until tester display shows no further increase.

Compression pressure:

- New: 25 to 31 bar
- Wear limit: 19 bar

Permissible difference between all cylinders:

- 5 bar

- Install glow plugs using 3220 flexible wrench
  - Tightening torque: 15 N.m (11 ft lb)
- Check Diagnostic Trouble Code (DTC) memory:

  See **DTC MEMORY, CHECKING**

NOTE: **Trouble codes will be stored because the Diesel injection pump harness connector has been disconnected. Check and erase DTC memory.**

VALVE TRAIN, SERVICING

NOTE: Cylinder heads with cracks between the valve seats may be used without reducing engine life, provided the cracks are small and not more than 0.5 mm wide.

NOTE: The following list refers to items in Fig. 80 .

1. **Bearing cap**
   - Installation position. See **Camshaft bearing caps, installed position**
   - Installation sequence. See **CAMSHAFT, REMOVING AND INSTALLING**
2. **20 N.m (15 ft lb)**
3. **Camshaft**
   - Axial clearance, checking. See **Camshaft axial clearance, checking**
   - Removing and installing: See **CAMSHAFT, REMOVING AND INSTALLING**
   - Checking radial clearance with plastigage Wear limit: 0.11 mm
   - Run-out: max. 0.01 mm
   - Identification and valve timing. See **Identification**
4. **Hydraulic lifter**
   - Do not interchange
   - Checking. See **HYDRAULIC LIFTERS, CHECKING**
   - Store with cam contact surface facing downward
   - Before installing, check camshaft axial clearance. See **Camshaft axial clearance, checking**
   - Oil contact surfaces
5. **Keepers**
6. **Upper valve spring plate**
7. **Valve spring**
   - Removing and installing: With cylinder head removed Use 2037 With cylinder head installed. See **VALVE STEM SEALS, REPLACING**
8. **Valve stem seal**
   - Replacing. See **VALVE STEM SEALS, REPLACING**
9. **Valve guide**
   - Checking. See **VALVE GUIDES, CHECKING**
   - Replacing. See **VALVE GUIDES, REPLACING**
   - Service version with collar
10. **Oil seal**
    - To remove and install, remove bearing cap
    - Toothed belt, removing and installing. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
11. **Cylinder head**

- See note. See **VALVE TRAIN, SERVICING**
- Valve seats, reworking. See **VALVE SEATS, REWORKING**

12. **Valves**
    - Valve dimensions. See **Valve dimensions**

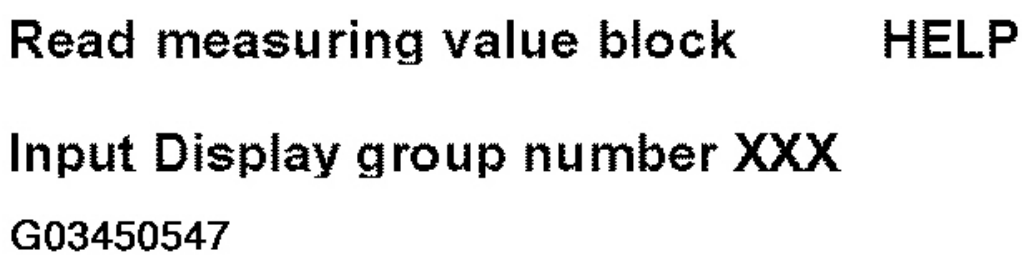


Fig. 80: Identifying Valve Train
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Camshaft axial clearance, checking

Fig. 81: Checking Camshaft Axial Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- VW 387 Universal dial gauge bracket
- Dial gauge

NOTE: Check with hydraulic lifters removed and with first and last bearing caps

fitted.

- Wear limit: max. 0.15 mm

Camshaft bearing caps, installed position

Fig. 82: Identifying Camshaft Bearing Caps Position
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Note offset. Before installing camshaft trial install the bearing caps and determine the correct position.

Valve dimensions

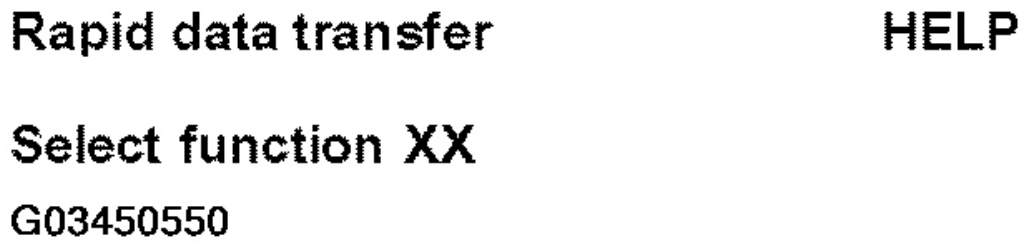


Fig. 83: Identifying Valve Dimensions
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Valves must not be reworked. Only lapping-in is permitted.

VALVE DIMENSION CHART

Dimension	Intake valve	Exhaust valve
diameter a mm	35.95	31.45
diameter b mm	6.963	6.943
c mm	96.85	96.85
"ALPHA ANGLE" °	45	45

Camshaft identification, valve timing

Identification

- Cam base diameter: a = 38 mm diameter
- Camshaft is identified by stamped numbers and letters between intake and exhaust cams:

CAMSHAFT IDENTIFICATION

Engine code	ALH
Cylinder 1 (arrow -A-)	38K
Cylinder 2 (arrow -B-)	DE

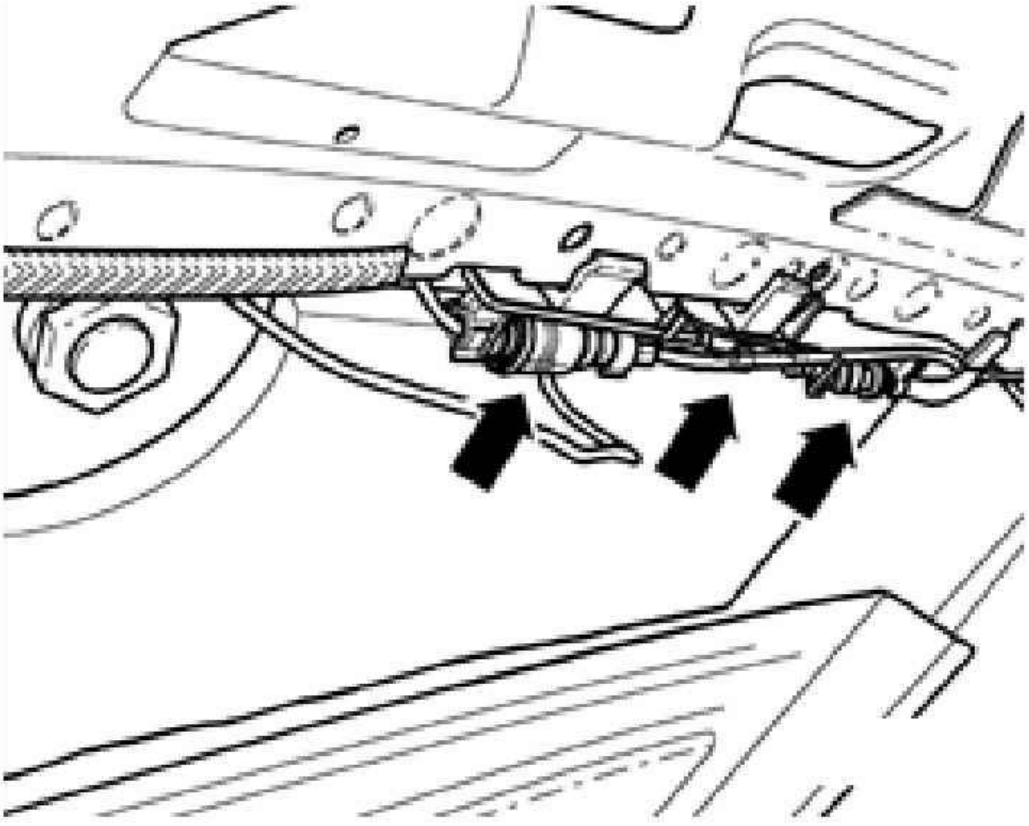


Fig. 84: Identifying Camshaft
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Valve timing at 1 mm valve lift

VALVE TIMING CHART

Engine code	ALH
Intake opens after TDC	16 °
Intake closes after BDC	25 °
Exhaust opens before BDC	28 °
Exhaust closes before TDC	19 °

Valve seats, reworking

Special tools and equipment

- Depth gauge
- Valve seat refacing tool

NOTE:

- **When repairing engines with leaking valves, it is not always sufficient to merely reface or replace valve seats and valves. It is also necessary to check the valve guides for wear. This is particularly important on high mileage engines.**
- **The valve seats should only be reworked enough to produce a perfect seating pattern. The maximum permissible reworking dimension must be calculated before reworking starts. If this dimension is exceeded, the hydraulic lifter function can no longer be guaranteed and the cylinder head should be replaced.**

Maximum permissible reworking dimension, calculating:

- Insert valve and press firmly against seat.

NOTE: **If the valve will be replaced as part of a repair, use the new valve for the calculation.**

- Measure distance -a- between end of valve stem and upper edge of cylinder head.
- Calculate maximum permissible reworking dimension from measured distance -a- and minimum dimension.

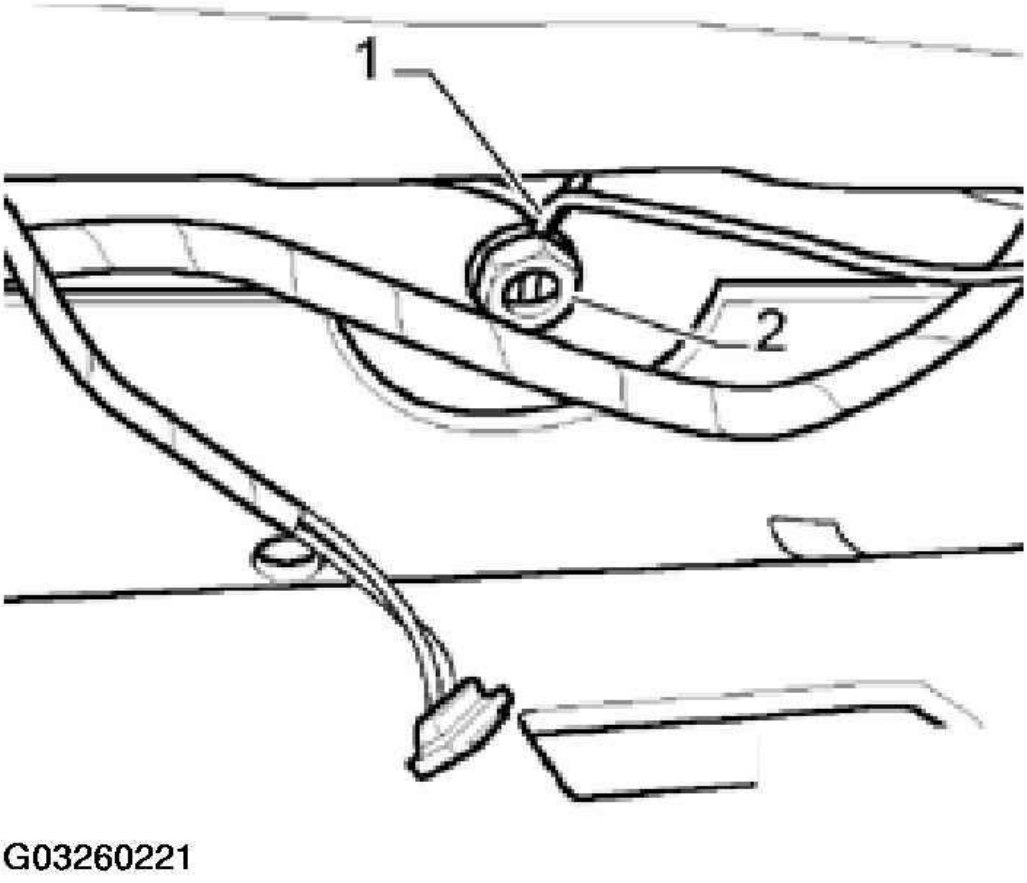


Fig. 85: Measuring Distance Between End Of Valve Stem And Upper Edge Of Cylinder Head
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Minimum dimension:

Intake valve 35.8 mm

Exhaust valve 36.1 mm

Measured distance minus minimum dimension = Maximum permissible reworking dimension.

Example:

MAXIMUM PERMISSIBLE REWORKING DIMENSION (EXAMPLE)

Dimension	Measurement
Measured distance	36.5 mm

Minus Minimum dimension	35.8 mm
= Max. perm. rework dimension	0.7 mm

Intake valve seat, reworking

a = 35.7 mm diameter

b =1.6 mm

45° = Valve seat angle

NOTE: The 30° lower valve seat chamfer is necessary to make sure that the intake channel flow characteristics are maintained.

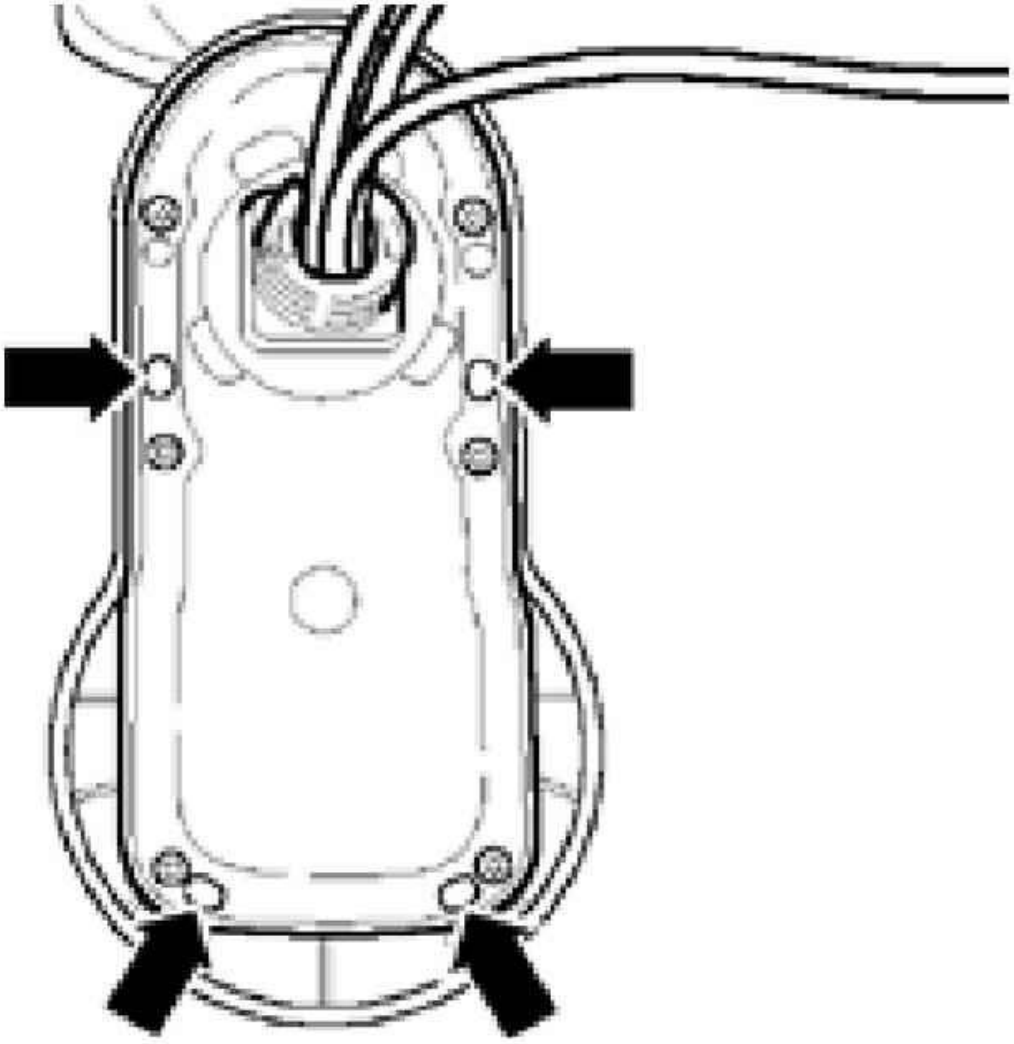


Fig. 86: Identifying Intake Valve Seat Angle
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Exhaust valve seat, reworking

a = 31.4 mm diameter

b =2.7 mm

45°= Valve seat angle

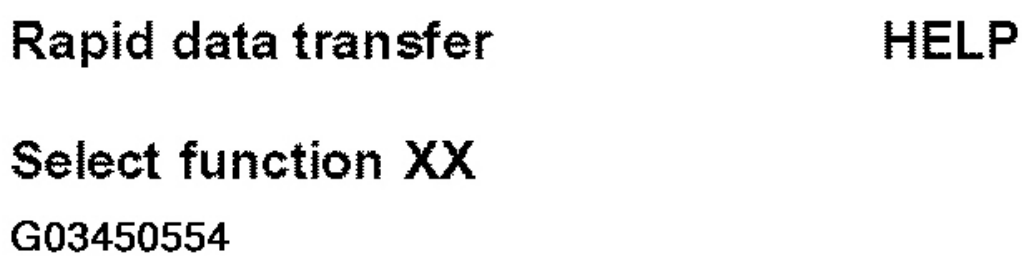
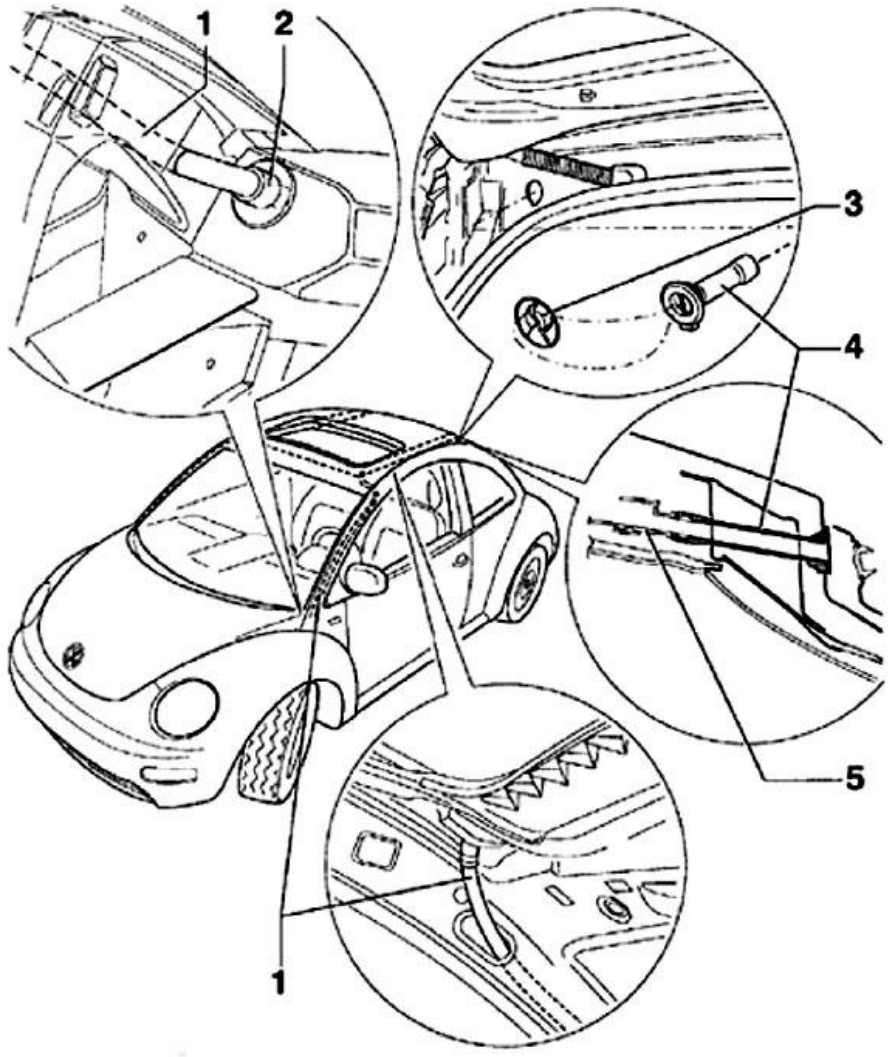


Fig. 87: Identifying Exhaust Valve Seat Angle
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Valve guides, checking

Special tools and equipment

- VW 387 Universal dial gauge bracket
- Dial gauge



1 - Front water drain hoses.

2 - Front water drain valve.

3 - Cover.

4 - Water drain hose with valve.

5 - Carrier unit.

Fig. 88: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Test sequence

- Insert new valve into guide until end of valve stem is flush with end of guide. Due to slight differences in stem dimensions, make sure that an intake valve is used in intake guide and an exhaust valve in exhaust guide.
  - Rock: 1.3 mm maximum

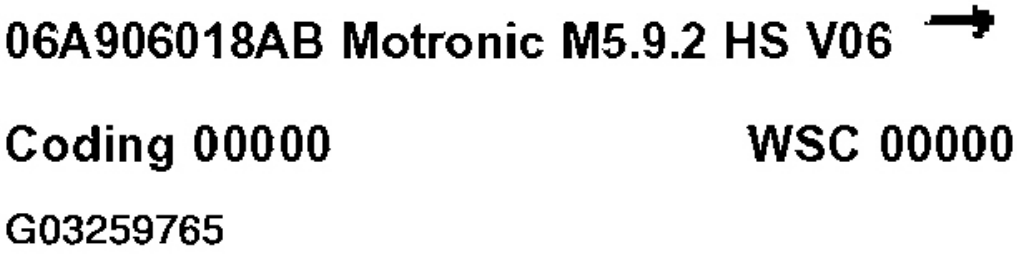


Fig. 89: Measuring Valve Rock
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Valve guides, replacing

Special tools and equipment

- 3121 Drift

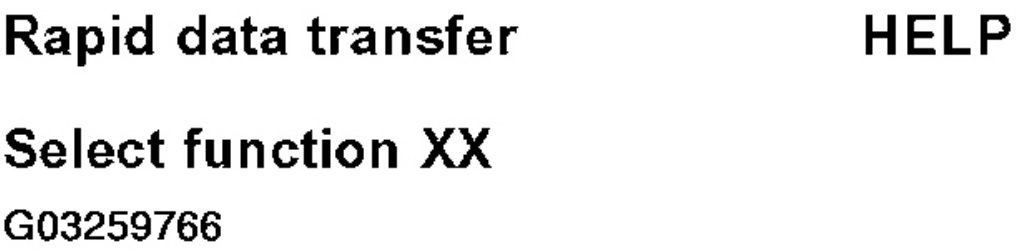


Fig. 90: Identifying 3121 Drift
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- 3120 Reamer and cutting fluid

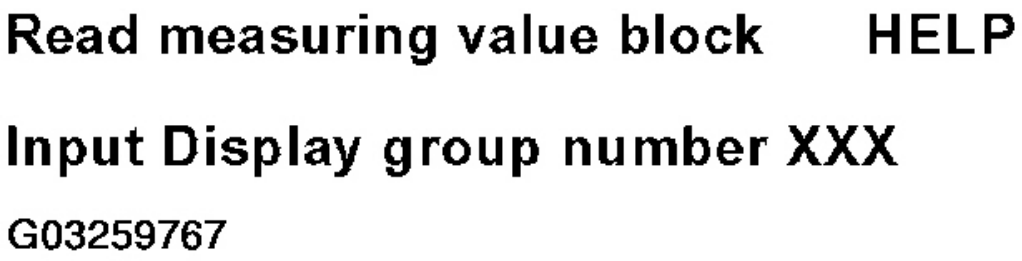


Fig. 91: Identifying 3120 Reamer And Cutting Fluid
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Clean and check cylinder head.

NOTE: Do not replace the valve guides in cylinder heads where the valve seats can no longer be reworked, or cylinder heads which have already been machined to the minimum dimension.

- Press out worn valve guides using 3121 from camshaft side (valve guides with shoulder service version from combustion chamber side).

Installing

- Press new guides in up to shoulder (moistened with oil) from camshaft side in cold cylinder head using 3121 drift.

NOTE: When the valve guide shoulder makes contact, do NOT allow the pressure to exceed 2000 psi or shoulder could break off.

- Ream out guides with 3120 hand reamer and plenty of cutting fluid.
- Rework valve seats. See **VALVE SEATS, REWORKING**

Valve stem seals, replacing

Special tools and equipment

- 2036 Adjustable rod
- 3047A Slide hammer
- 3129 Seal driver

- VW 541/1A Valve spring lever
- VW 541/5 Thrust piece

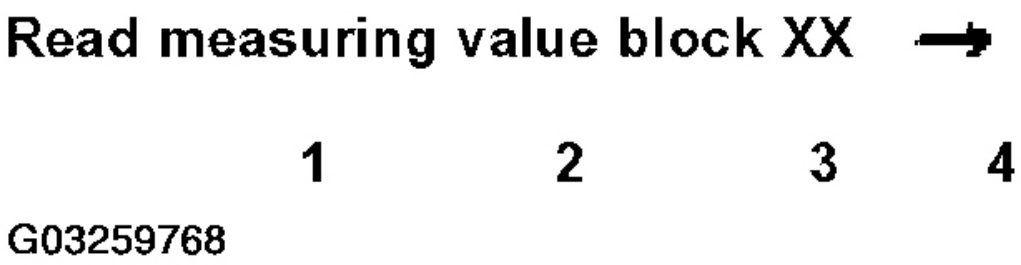


Fig. 92: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

(with cylinder head installed)

- Remove camshaft. See **CAMSHAFT, REMOVING AND INSTALLING**
- Remove hydraulic lifters and set them with contact surfaces facing down. Make sure lifters are not interchanged in process.
- Set piston of respective cylinder to Top Dead Center.
- Install 2036 adjustable rod and adjust mountings to height of studs.

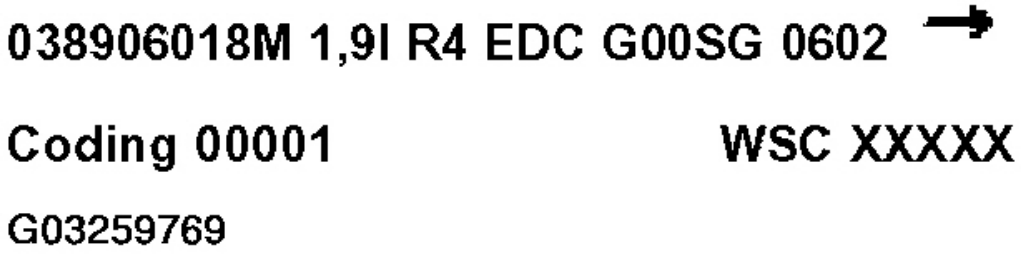


Fig. 93: Installing 2036 Adjustable Rod And Adjust Mountings
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove valve springs with VW 541/1A lever and VW 541/5 press piece.

NOTE: The valves are supported by the piston crown.

- Remove valve stem seals using 3047A.

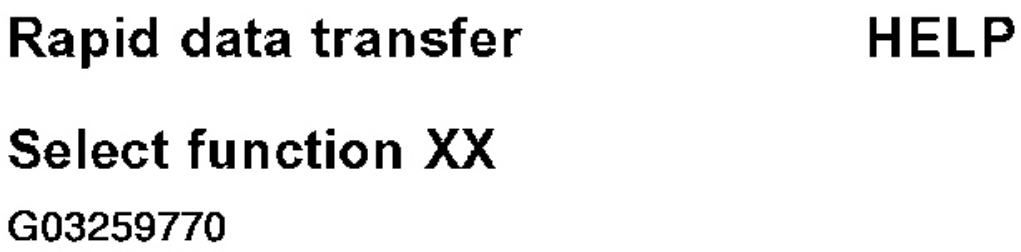


Fig. 94: Removing Valve Stem Seals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

- Place plastic sleeve supplied on appropriate valve stem. This will prevent new valve stem seal from being damaged.
- Insert new valve stem seal in 3129 installation tool.
- Oil valve stem seal sealing lip and press carefully onto valve guide.

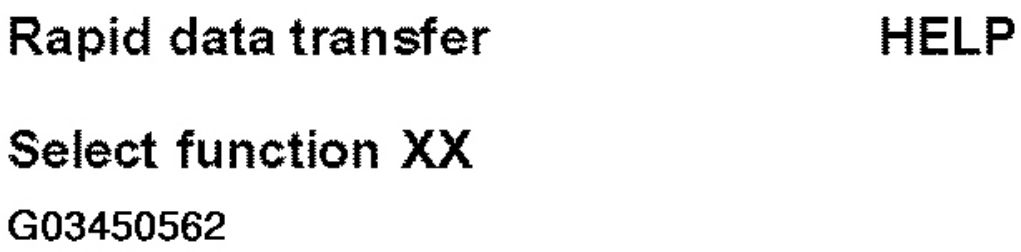


Fig. 95: Installing Plastic Sleeve On Valve Stem
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Camshaft, removing and installing

Special tools and equipment

- 3359 Rig pin
- 3418 Adjustment guide
- V159 Nut wrench
- VAG 1331 Torque wrench: 5 to 50 N.m (3.7 to 37 ft lb)

Fig. 96: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove connecting pipe between charge air cooler and intake hose. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING**
- Remove toothed belt guard, upper section.
- Remove valve cover.
- Remove brake booster vacuum pump.

Vehicles with manual transmission:

- Turn crankshaft to cyl. 1 TDC.

Fig. 97: Identifying Mark (Vehicles With Manual Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with automatic transmission:

- Turn crankshaft to cyl. 1 TDC.

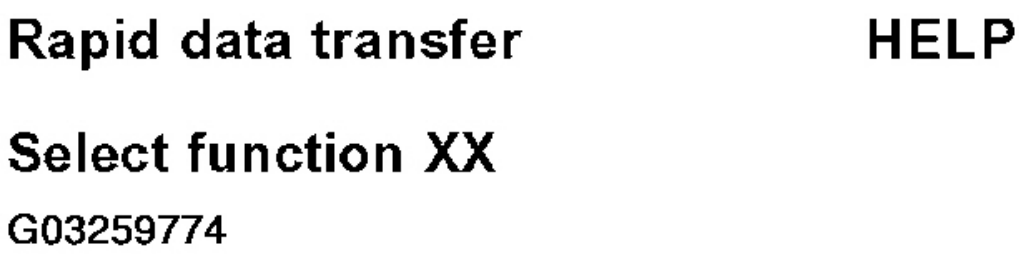


Fig. 98: Identifying Mark (Vehicles With Automatic Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lock camshaft with setting bar.

Rapid data transfer Q

11 - Login procedure

G03259775

Fig. 99: Installing Setting Bar On Camshaft
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Release tensioning roller and take toothed belt off camshaft sprocket.
- Loosen camshaft sprocket mounting bolt 1/2 turn.
- Release camshaft sprocket from camshaft taper by tapping with a hammer (using a drift through rear toothed belt guard opening).
- Take off camshaft sprocket.
- First remove bearing caps 5, 1 and 3. Then loosen bearing caps 2 and 4 alternately and diagonally.

Installing

NOTE:

- **When installing the camshaft, No. 1 cylinder cams must point upward.**
- **When installing the bearing cap, note offset before installing camshaft, install bearing caps and determine installed position.**

Login procedure

Input Code Number XXXXX

G03259776

Fig. 100: Identifying Bearing Caps Position
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Oil camshaft contact surfaces.
- Install camshaft.
- Tighten bearing caps: 2 and 4 alternately and diagonally
  - 20 N.m (15 ft lb)
- Install bearing caps: 5, 1 and 3.
  - 20 N.m (15 ft lb)
- Position bearing cap 5 by gently tapping on end of camshaft.
- Install camshaft sprocket.
- Install toothed belt and tension. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING** .

Assembly is basically a reverse of the disassembly sequence.

NOTE: Do NOT start the engine for approx. 30 minutes after new lifters have been installed. Hydraulic compensation elements must settle (otherwise the valves will strike pistons).

Hydraulic lifters, checking

Special tools and equipment

- Feeler gauge
- Wood or plastic wedge

NOTE:

- **Replace faulty lifter assembly (cannot be adjusted or repaired).**
- **Irregular valve noises are normal when starting the engine.**

Test sequence

- Start engine and run until engine oil temperature is 80° C minimum
- Increase engine speed to 2500 RPM for approx. 2 minutes.

If lifters are still noisy, locate faulty lifter(s) as follows:

- Remove valve cover.
- Rotate crankshaft clockwise, until cam of lifter to be checked is pointing upward.
- Measure play between cam and lifter.

If play is in excess of 0.1 mm

- Replace hydraulic lifter assembly

If play is less than 0.1 mm or no play

- Proceed with check as follows
- Press down on lifter with a wooden or plastic wedge.

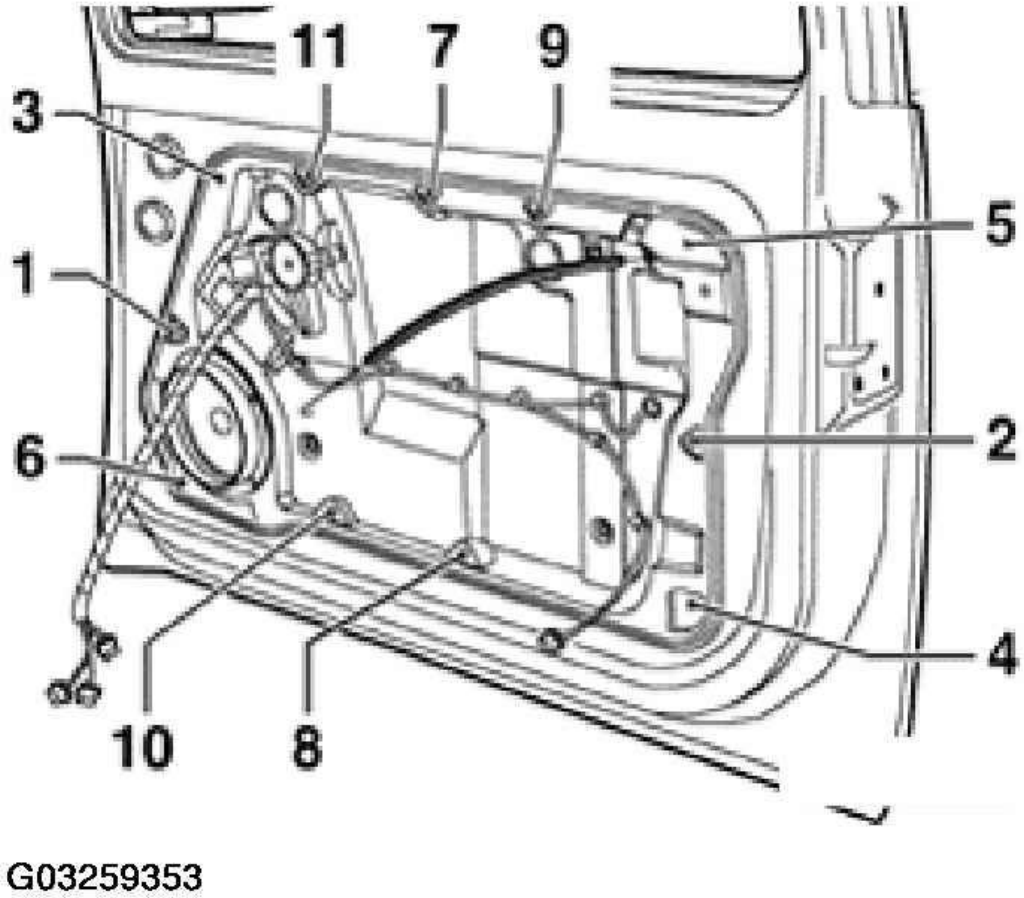


Fig. 101: Identifying Press Down On Lifter With A Wooden Or Plastic Wedge
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If 1 mm or more of travel is felt before the lifter touches the valve:

- Replace hydraulic lifter assembly

NOTE: Do NOT start the engine for approx. 30 minutes after new lifters have been

installed. Hydraulic compensation elements must settle or the valves will strike the pistons.

ENGINE - LUBRICATION

LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING

NOTE:

- **If large quantities of metal particles or other deposits (caused, for example, by partial seizure of the crankshaft or conrod bearings) are found in the engine oil when performing repairs, clean the oil passages thoroughly and replace the oil cooler (mandatory) to prevent future damage.**
- **The oil level must NOT be above the MAX. mark-there is the possible danger of damaging the catalyst!**

Oil pressure, checking. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING** .

Oil capacity up to MY 2000

- With oil filter 4.5 liters (4.75 quarts)

Oil capacity from MY 2001

See maintenance guide with owner's manual.

Engine oil specifications:

The following terms must appear on the oil container singly or in combination with other designations:

- VW 505 00
- ACEA B3 or ACEA B4
- API Service CF4 or API Service CG4

- Engine oils are graded according to their viscosity. The proper grade to be used in your engine depends on existing climatic or seasonal conditions.
- The engine oil which was first put into your engine has a viscosity grade of SAE 5W-40. You can use this oil over all temperature ranges for normal driving. If engine oil viscosity grade SAE 5W-40 is not available, you can also use SAE 5W-30.

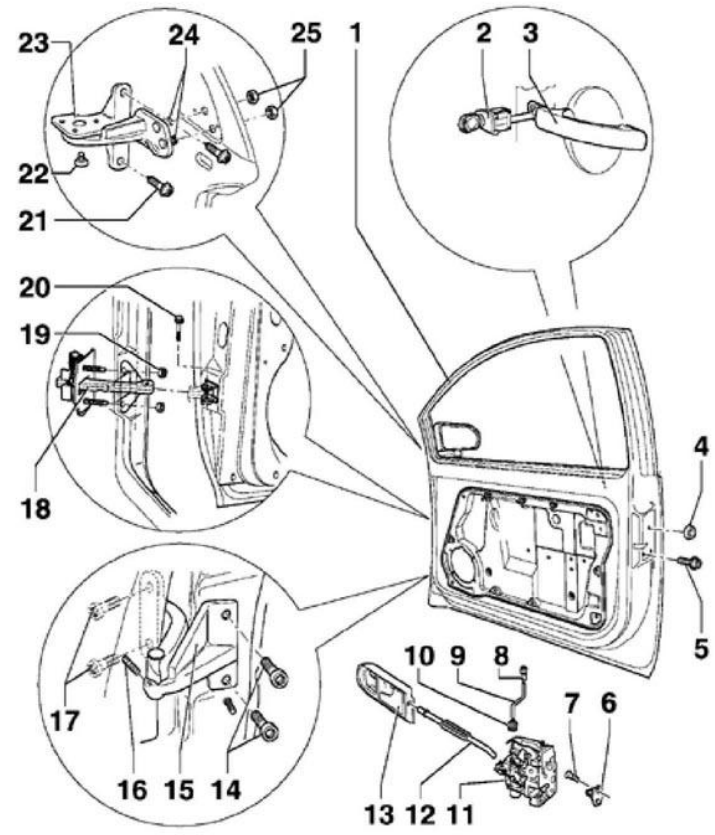
Part I

Oil filter bracket, disassembling. See **PART II**

NOTE: The following list refers to items in Fig. 102 .

1. **Oil pump**
   - 12 bar pressure relief
   - Make sure both centering dowels are installed
   - Replace if any running surfaces or gears are scored
2. **Chain sprocket**
3. **N.m (18 ft lb)**
4. **Chain**
5. **Sealing flange**
   - Removing and installing: See **SEALING FLANGE (FRONT), REMOVING AND INSTALLING** .
   - Insert with silicone sealant D 176 404 A2. See **SEALING FLANGE (FRONT), REMOVING AND INSTALLING** .
   - Crankshaft oil seal, replacing (pulley side). See **SEALING RING (CRANKSHAFT PULLEY SIDE), REPLACING** .
6. **15 N.m (11 ft lb)**
7. **Chain tensioner (with tensioning rail)**
   - 15 N.m (11 ft lb)
   - To install, first pretension spring
8. **Dipstick**
   - Oil level must NOT be above the MAX. mark!
   - Marks: See **Dipstick, markings**
9. **Guide**
   - Remove to draw out oil
10. **Guide tube**
11. **Centering dowels**
12. **O-ring**
    - Always replace
13. **Suction pipe**
    - Clean strainer if soiled
14. **Baffle plate**
15. **Oil pan**
    - Clean sealing surfaces before installing
    - Install with silicone sealant D 176 404 A2. See **OIL PAN, REMOVING AND INSTALLING**
16. **Seal**
    - Integral with oil drain plug
17. **Oil drain plug**
    - 30 N.m (22 ft lb)
    - Replace if leaking. See Parts Catalog for correct application. In some cases, seal and drain plug are

combined; do not interchange with separate seal and drain plug.



1 - Door
2 - Lock cylinder housing
3 - Door handle with base
4 - Cover cap
5 - Bolt/screw
6 - Lock plate
7 - Bolt/screw
8 - Locking button
9 - Locking button
10 - Boot
11 - Door lock
12 - Bowden cable
13 - Interior release handle
14 - Bolt/screw
15 - Door hinge
16 - Grub screw
17 - Bolt/screw
18 - Door arrester
19 - Nut
20 - Pin
21 - Bolt/screw
22 - Bolt/screw
23 - Door hinge
24 - Pin
25 - Nut

Fig. 102: Exploded View Of Lubrication System Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 103 .

1. **Sealing plug**
   - 25 N.m (18 ft lb)
2. **Gasket**
   - Always replace
3. **Oil cooler**
   - Make sure clearance between adjacent components
   - See note. See **LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING**
4. **Gasket**
   - Always replace
   - Install into oil cooler groove
5. **Seal**
   - If seal leaks, nip open and replace.
6. **Plug**
   - 10 N.m (7 ft lb)
7. **Sealing plug**
   - Do NOT open
8. **Spring**
   - For pressure relief valve, approx. 5 bar
9. **Piston**
   - For pressure relief valve, approx. 5 bar
10. **0.9 bar oil pressure switch -F1-**
    - 25 N.m (18 ft lb)
    - Gray
    - Checking: See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING**
11. **Gasket**
    - Always replace
12. **15 N.m (11 ft lb) plus additional1/4 turn (90°)**
    - Always replace
    - Place bolts first top left and right, then tighten all four bolts over cross
13. **Oil filter bracket**
14. **Seal**
    - Always replace
15. **Oil supply pipe**
    - To the turbocharger

16. **Banjo bolt**
    - 20 N.m (15 ft lb)
17. **Sealing cap**
    - 25 N.m (18 ft lb)
    - Loosen and tighten using 3417 oil filter wrench
18. **O-ring**
    - Always replace
19. **Oil filter element**

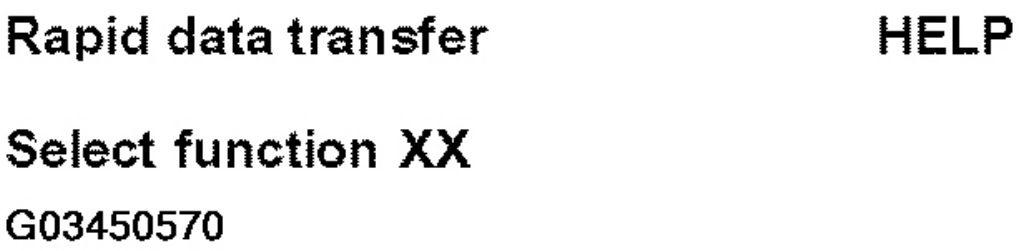


Fig. 103: Exploded View Of Oil Filter Bracket Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Dipstick, markings

NOTE: The following lists refers to items in Fig. 104 .

1. MAX. mark
2. MIN. mark

a. Area above cross-hatched zone up to the MAX. mark:

   Do not top-up with engine oil!

b. Oil level within cross-hatched zone:

   Can be topped-up with engine oil, as necessary

c. Area from MIN. mark up to cross-hatched zone:

   Fill with 0.5 ltr. (.47 quarts) of engine oil maximum!

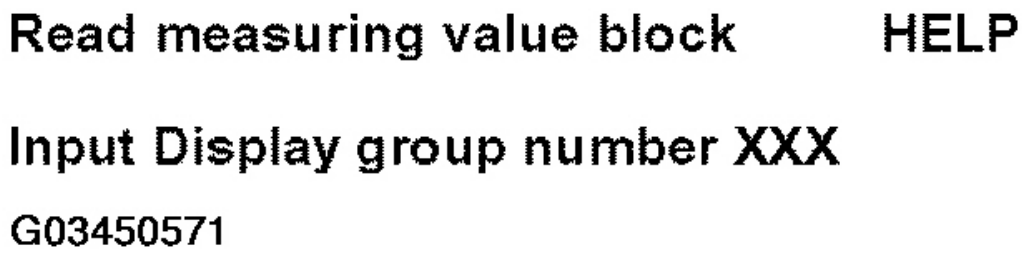


Fig. 104: Identifying Oil Level Mark On Dipstick
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Oil pan, removing and installing

Special tools and equipment

- Hand drill with plastic brush
- D 176 404 A2 Silicone sealant
- Scraper

Oil pan, removing

- Remove center, left and right insulation trays:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Drain engine oil.
- Unscrew oil pan.
- Loosen oil pan with light blows from a rubber hammer, if necessary.
- Remove sealant residue on cylinder block with a flat scraper.
- Remove sealant residue on the oil pan with a rotating brush, e.g. a hand drill with a plastic brush (wear protective glasses).
- Clean sealing surfaces, must be free of oil and grease.

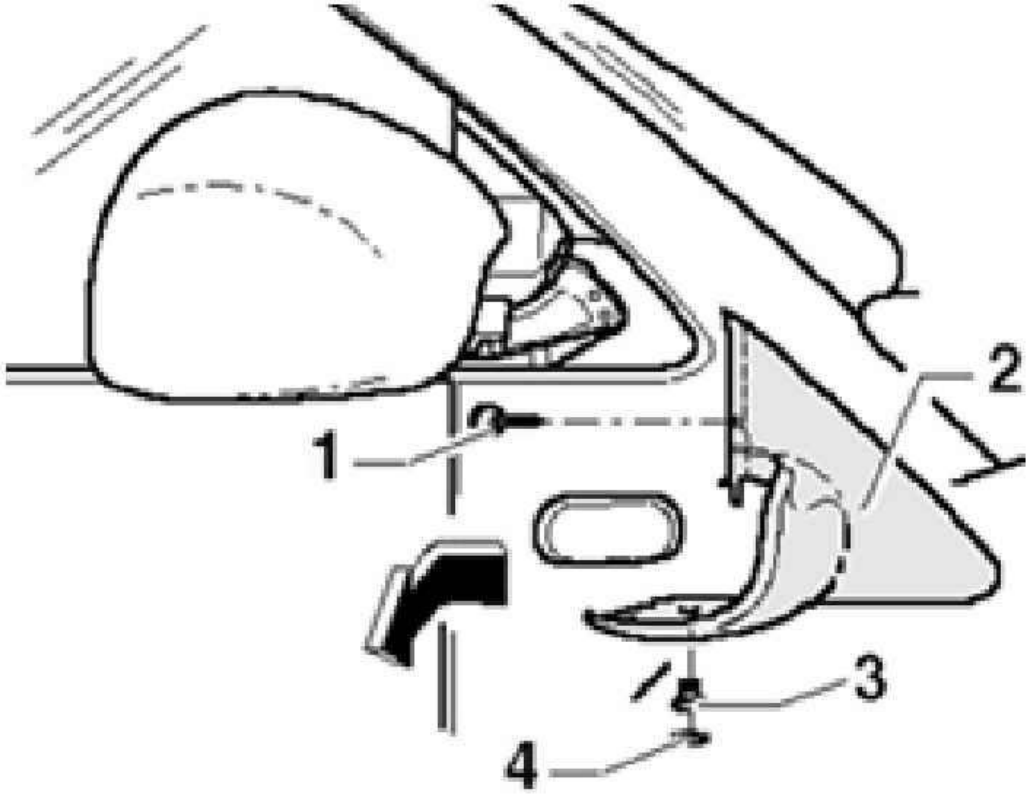


Fig. 105: Removing Sealant Residue On Oil Pan
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE:

- **Note the "use by date" on the sealant container.**
- **Oil pan must be installed within 5 minutes after applying the silicone sealing compound.**

- Cut-off tube nozzle at forward mark (approx. 3 mm diameter).
- Apply silicone sealing compound as shown to a clean oil pan sealing surface.
  - Bead must be: 2 to 3 mm thick.
  - Bead must run on the inside of bolt holes (arrows).

NOTE: The sealing bead must not be thicker, or excess compound will enter

the oil pan and may block the suction pipe strainer.

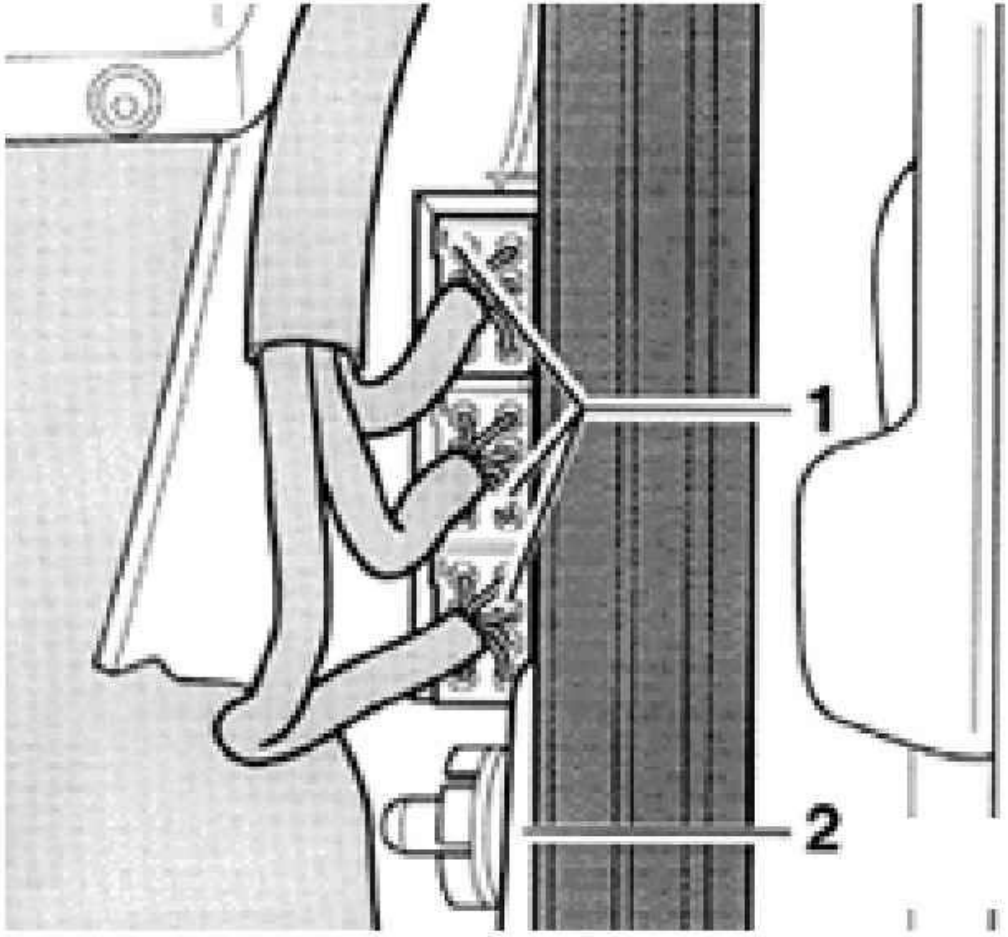


Fig. 106: Applying Silicone Sealing Bead On Oil Pan (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Apply silicone sealing bead as shown to the clean sealing surface of the oil pan. (illustration shows position of sealant bead on cylinder block).
- Immediately install oil pan and lightly tighten all bolts.

NOTE: The oil pan must be aligned flush with the cylinder block.

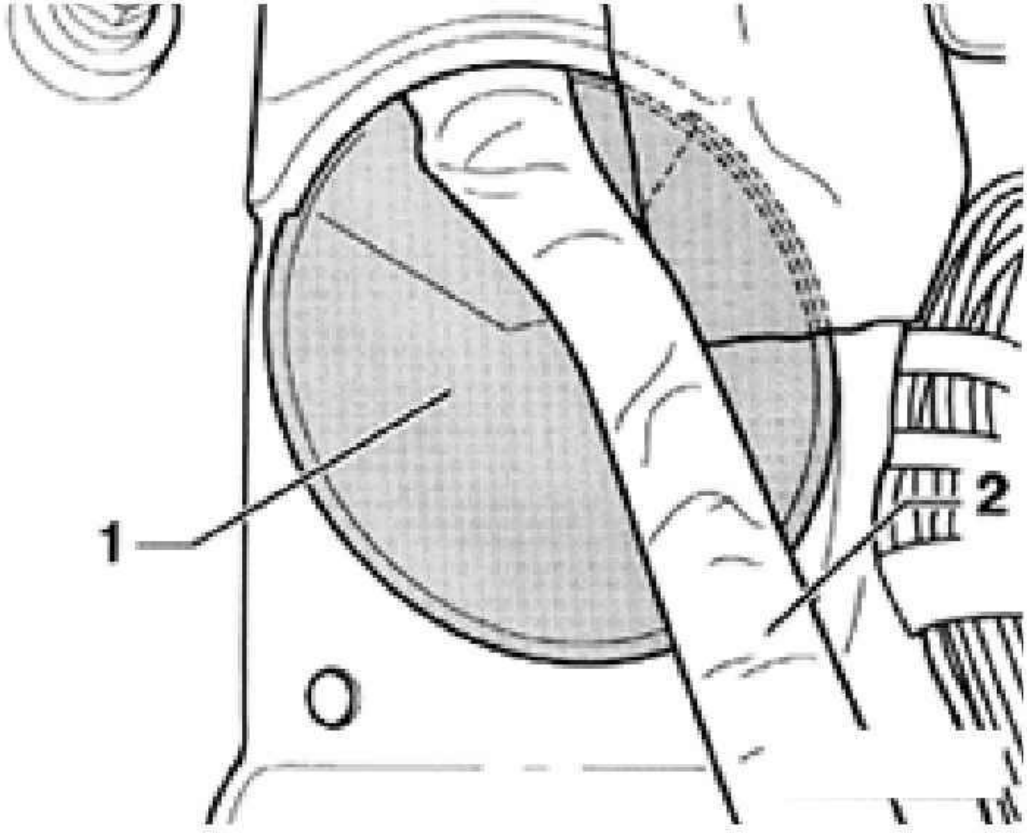


Fig. 107: Applying Silicone Sealing Bead On Oil Pan (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten oil pan bolts to 15 N.m (11 ft lb).
- Tighten oil pan/transmission bolts to 45 N.m (33 ft lb).

NOTE:

- **After installing the oil pan, allow the sealant to dry for approx. 30 minutes before adding engine oil.**
- **Assembly is the reverse of the disassembly sequence.**

Oil pressure and oil pressure switch, checking

Special tools and equipment

- VAG 1342 Oil pressure gauge

- VAG 1527 B Voltage tester
- VW 1594 adapter kit

NOTE: Functional check and servicing the optical and acoustic oil pressure warning:
See appropriate WIRING DIAGRAM article

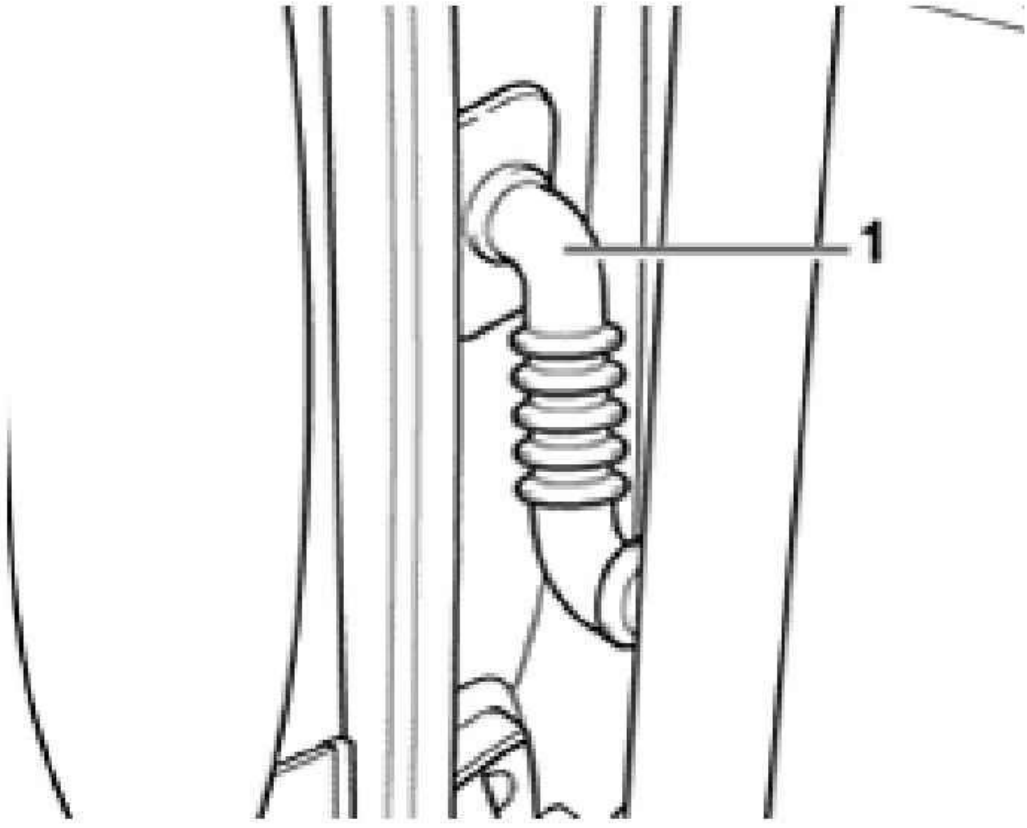


Fig. 108: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Test sequence

- Remove oil pressure switch -F1- and screw into tester.

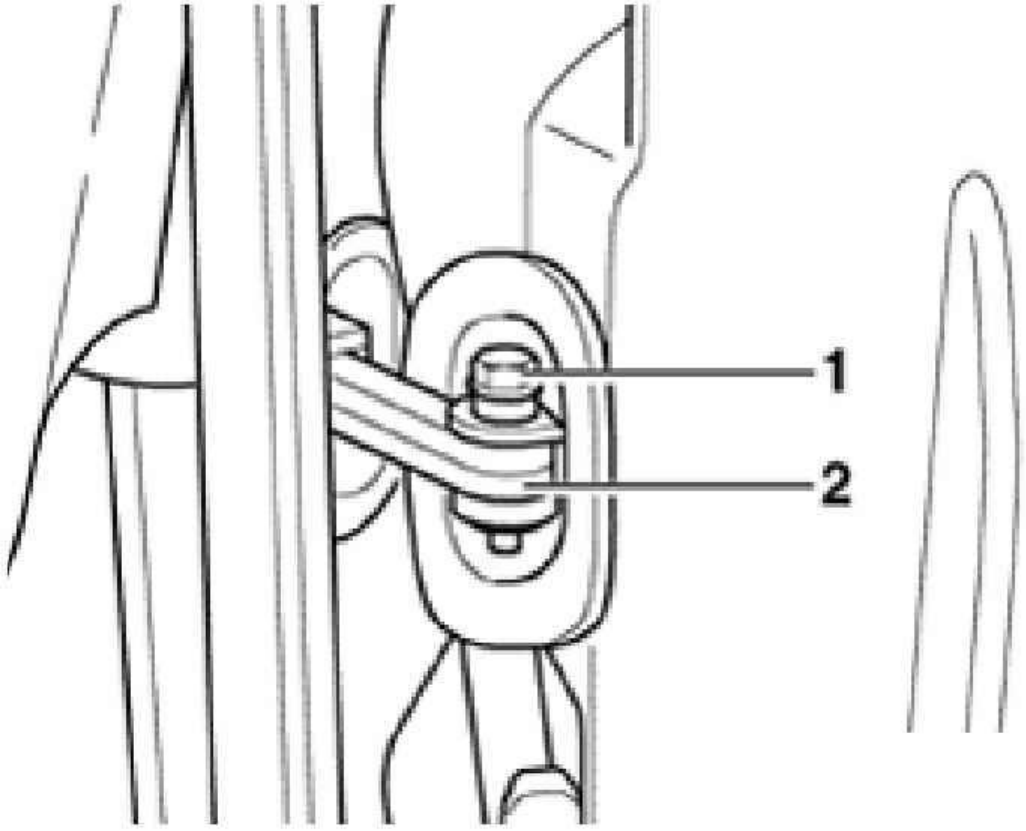


Fig. 109: Checking Oil Pressure Switch
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Screw tester into filter bracket in place of pressure switch.
- Connect brown tester wire to Ground.
- Connect VAG 1527B Voltage tester between battery Plus and oil pressure switch using jumper wires from VW 1594 adapter kit.

If LED lights up:

- Replace oil pressure switch -F1-.

If LED does not light up:

- Start engine and slowly increase engine speed.

At 0.75 to 1.05 bar, LED must light up. If not replace oil pressure switch -F1-.

- Increase engine speed further.

  At 2000 RPM and an oil temperature of 80°C, oil pressure must be 2.0 bar minimum.

NOTE: **At higher engine speeds, oil pressure must not exceed 7.0 bar. If necessary replace oil pump cover complete with pressure relief valve.**

Engine Mechanical - New Beetle, 2.0L 4-Cyl. - AEG, AVH, AZG, BDC, BEV, BGD

GENERAL, TECHNICAL DATA

TECHNICAL DATA

Engine number

The engine number ("Code letters" and "Serial number") can be found on the joint between engine/transmission.

The engine number consists of up to nine characters (alphanumeric). The first part (maximal 3 characters) makes up the "engine code", and the second part (6 characters), the "serial number". If more than 999,999 engines with the same engine code are produced, the first of the six characters is replaced with a letter.

Additionally there is a sticker on the toothed belt guard with "Engine code" and "Serial number".

The engine code is also included on the vehicle data plate.

Engine code AEG

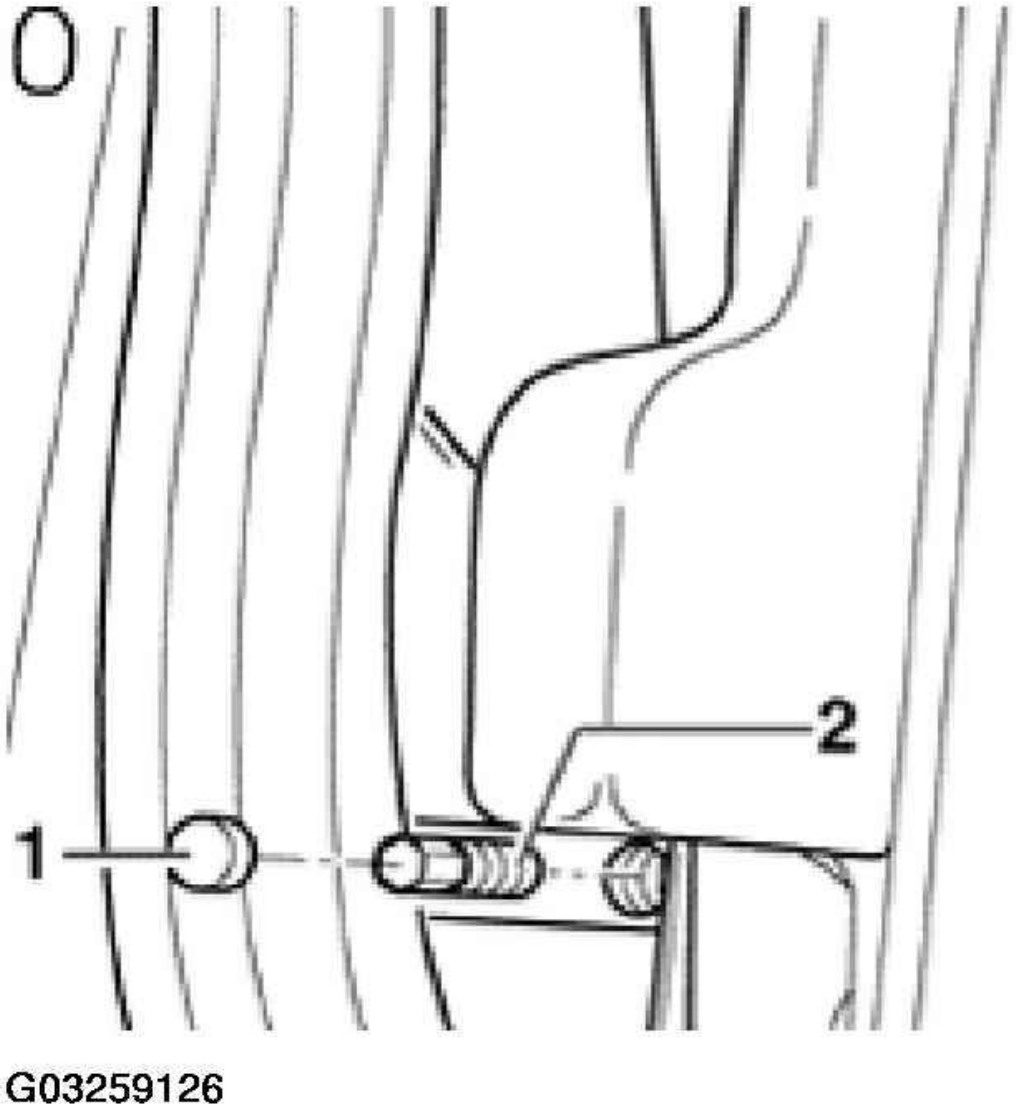


Fig. 1: Locating Engine Code AEG
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine codes AVH, AZG, BDC, BEV, BGD

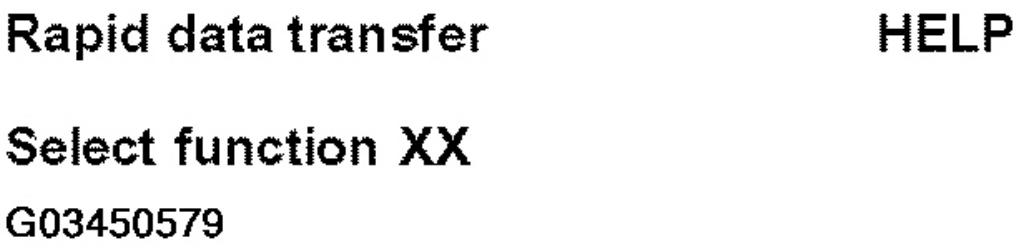


Fig. 2: Locating Engine Codes AVH, AZG, BDC, BEV, BGD
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine data

ENGINE DATA (1 OF 4)

Code	AEG	AVH	AZG	BDC
Manufactured	02.98 & Up	08.00 & Up	10.00 & Up	08.02 & Up
Exhaust emissions fulfil	LEV(1)	ULEV(2)	LEV(1)	ULEV(2)
Capacity ltr.	2.0	2.0	2.0	2.0
Output kW at rpm	85/5400	85/5200	85/5200	85/5400
Torque N.m at rpm	165/2800	165/2600	165/2600	170/3000
Bore diameter mm	82.5	82.5	82.5	82.5
Stroke mm	92.8	92.8	92.8	92.8
Compression ratio	10.0	10.0	10.0	10.0
RON min.	91 unleaded	91 unleaded	91 unleaded	91 unleaded
Injection, ignition	Motronic 5.9.2	Motronic ME7.5	Motronic ME7.5	Motronic ME7.5
Knock control	2 knock sensors	2 knock sensors	2 knock sensors	2 knock sensors
Oxygen sensor control	2 sensors	2 sensors	2 sensors	2 sensors
Self-diagnosis	OBDII	OBDII	OBDII	OBDII

(1) 1) LEV = Low Emission Vehicle

(2) 2) ULEV = Ultra Low Emission Vehicle

ENGINE DATA (2 OF 4)

Code	AEG	AVH	AZG	BDC
Catalyst	yes	yes	yes	yes
Exhaust gas recirculation	no	no	no	no
Charging	no	no	no	no
Secondary air system	yes	yes	yes	yes
Variable intake manifold	no	no	no	yes
Variable valve timing	no	no	no	no
Electronic Power Control (EPC)	no	yes	yes	yes

ENGINE DATA (3 OF 4)

Code	BEV	BGD
Manufactured	06.03 & Up	06.03 & Up
Exhaust emissions fulfil	LEV2(1)	ULEV2(2)
Capacity - ltr.	2.0	2.0
Output - kW at rpm	85/5200	85/5400
Torque - N.m at rpm	165/2600	170/3000
Bore diameter - mm	82.5	82.5
Stroke - mm	92.8	92.8
Compression ratio	10.0	10.0
RON - min.	91 unleaded	91 unleaded
Injection, ignition	Motronic ME7.5	Motronic ME7.5
Knock control	2 knock sensors	2 knock sensors
Oxygen sensor control	2 sensors	2 sensors
Self-diagnosis	OBDII	OBD II

(1) LEV = Low Emission Vehicle

(2) ULEV = Ultra Low Emission Vehicle

ENGINE DATA (4 OF 4)

Code	BEV	BGD
Catalyst	yes	yes
Exhaust gas recirculation	no	no
Charging	no	no
Secondary air system	yes	yes
Variable intake manifold	no	yes
Variable valve timing	no	no
Electronic Power Control (EPC)	yes	yes

ENGINE - ASSEMBLY

ENGINE, REMOVING AND INSTALLING

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 2024 A Lifting tackle
- T10012 Engine bracket
- VW 313 Support clamp
- VW 540 Engine and transmission support
- V.A.G 1202 A Workshop crane
- V.A.G 1306 Drip tray

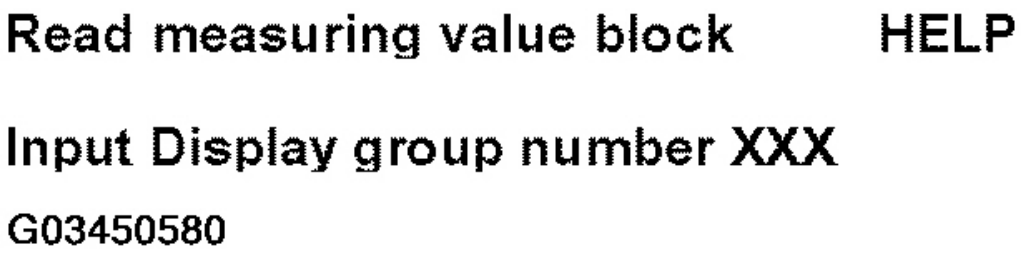


Fig. 3: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- V.A.G 1331 Torque wrench (5...50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)
- V.A.G 1383 A

  Engine/transmission jack

- VAS 5024

  Assembly tool for spring-type clips

- VW 540/1 B

  Supplementary set

- VAS 5085 Step ladder
- G 000 100 Grease (vehicles with manual transmission)
- Bolt M1 0x 25/ 8.8

- Cable tie

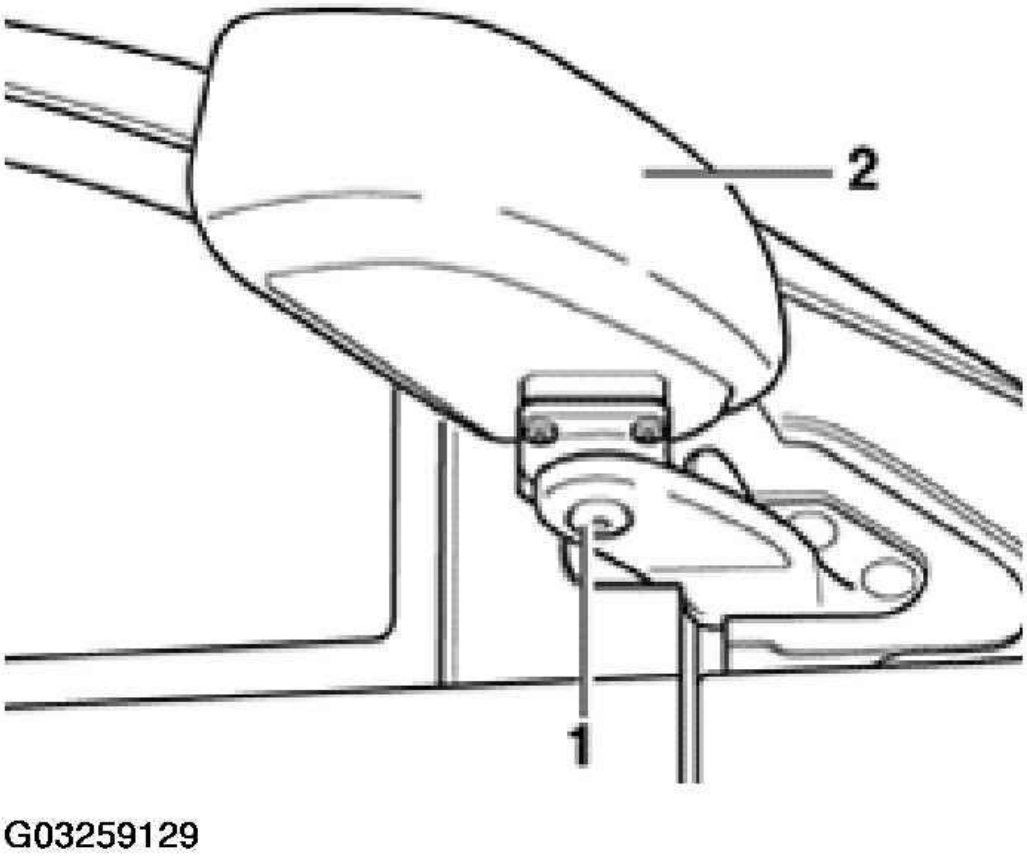


Fig. 4: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine removal notes

CAUTION: When performing repair work, especially due to the confined conditions in the engine compartment, pay attention to the following:

- **Route all types of lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum) as well as electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

NOTE: During the further course of work the battery Ground strap must be

disconnected. Therefore, please check whether a coded radio is installed. Obtain the radio code first, if necessary.

- Interrogate fault memories of all control modules before removing engine.

NOTE: **Some components in this vehicle cannot be removed or are very difficult to remove when the engine is installed in the engine compartment. For this reason determine which components are faulty before starting to remove components and replace the faulty components once they have been removed.**

- The engine is removed downward together with the transmission.
- All cable ties which are opened or cut open when removing engine, must be replaced in the same position when installing the engine.
  - With ignition switched off disconnect battery Ground strap.
  - Remove engine cover.
  - Remove power steering fluid reservoir from battery support but do not disconnect/open hoses.
  - Tie reservoir to lock support.
  - Remove battery and battery retainer.
  - Observe rules for cleanliness. See **RULES FOR CLEANLINESS** .

WARNING:

- **Fire Hazard! Do NOT have anything in the area that can ignite fuel!**
- **Fuel system is under pressure! Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.**

Engine codes AEG, AVH, AZG

- Pull fuel supply line -1- as well as fuel return line -2- off fuel rail and collect fuel that leaks out with a clean cloth.
- Pull hose off Evaporative Emissions (EVAP) canister purge regulator valve -N80-.

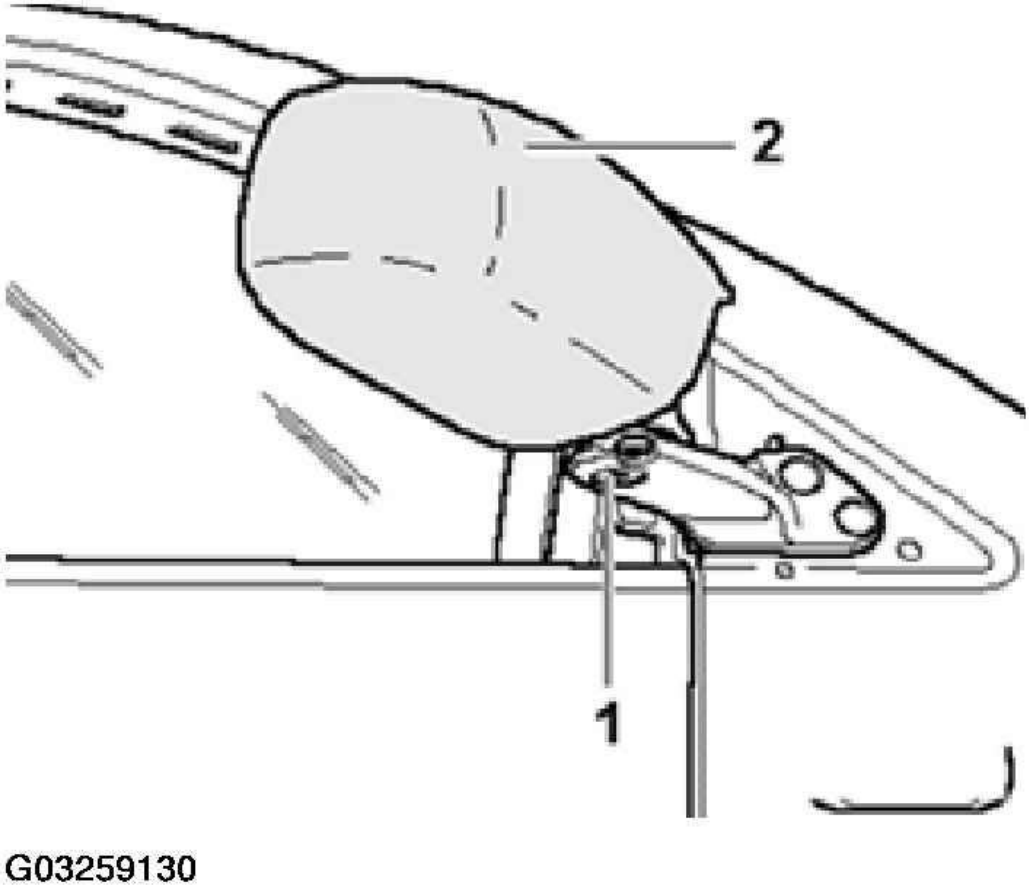


Fig. 5: Evaporative Emissions (EVAP) Canister Purge Regulator Valve Hoses - Engine Codes AEG, AVH, AZG
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine code BDC

- Pull fuel supply line -1- as well as fuel return line -2- off fuel rail and collect fuel that leaks out with a clean cloth.
- Pull hose off Evaporative Emissions (EVAP) canister purge regulator valve -N80-.

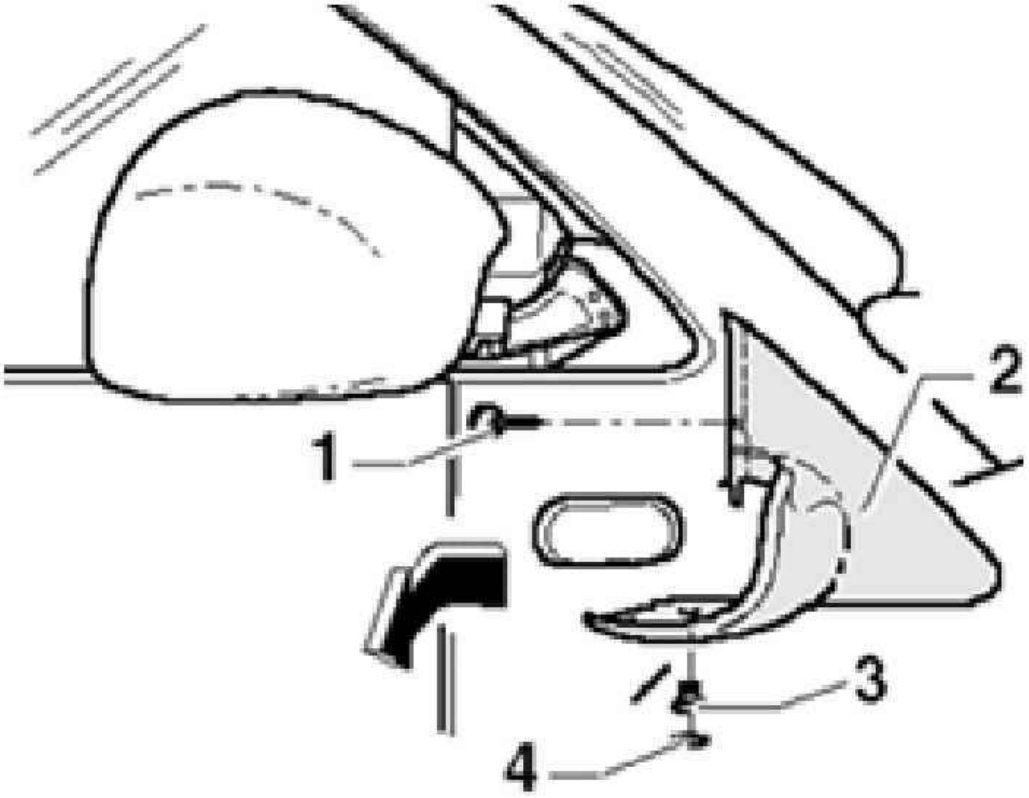


Fig. 6: Locating Fuel Supply/Return Lines & EVAP Canister Purge Regulator Valve - Engine Code BDC
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine codes BEV, BGD

- Pull fuel supply line -1- off union by pressing locking ring -2- into union -3- and collect fuel that leaks out with a clean cloth.

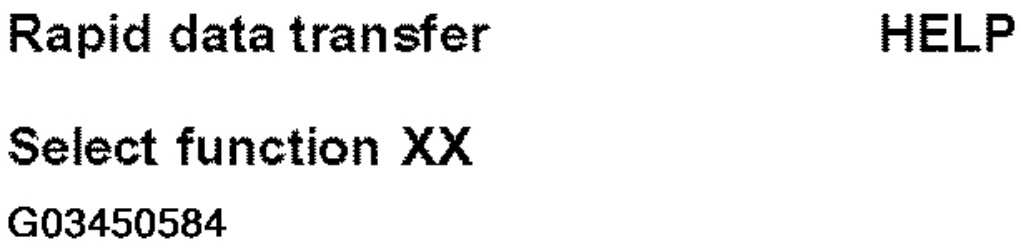


Fig. 7: Locating Fuel Supply Line Locking Ring - Engine Codes BEV, BGD
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Continuation for all models

- Seal lines to avoid contamination of fuel system.
- Pull vacuum and breather hoses off engine.
- Remove air cleaner with intake hose and Mass Air Flow (MAF) -G70-.
- Remove intake manifold upper part. See **INTAKE MANIFOLD UPPER PART, REMOVING AND INSTALLING** .

NOTE: Seal the intake ports in the intake manifold lower section with clean cloths.

Vehicles with manual transmission

- Disconnect shift mechanism from transmission.

  See **SELECTOR MECHANISM**

- Remove hydraulic clutch slave cylinder:

  See **CLUTCH SLAVE CYLINDER** .

NOTE: The clutch pedal must not be operated.

Vehicles with automatic transmission

- Remove selector lever cable from transmission:

  For transmission 01M, see **SELECTOR LEVER CABLE**

- Remove selector lever cable from transmission.

For transmission 09G, see **SELECTOR MECHANISM**

Continuation for all models

- Remove insulation tray.

  See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Drain coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .
- Remove ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Remove supplementary coolant fan on right side of vehicle, if part of original equipment.
- Remove power steering pressure line securing clamps on engine and transmission.
- Remove power steering pump from bracket and tie up to front panel; hoses remain connected.

  See **POWER STEERING PUMP, RESERVOIR, HYDRAULIC LINES** .

Vehicles with air conditioning

- Remove air conditioning compressor:

  See **CONDENSER, REMOVING AND INSTALLING** .

- Observe additional information and removal work. See **ADDITIONAL INFORMATION AND ASSEMBLY WORK ON MODELS WITH AN AIR CONDITIONING SYSTEM** .

Continuation for all models

- Disconnect inter-connecting, coolant, vacuum and intake lines on engine.
- Separate connections on following components:

  Ignition coils -N- and -N128- with

  Final output stage -N122- or Ignition coils with

  Final output stage -N70-, -N127-, -N291-; -N292-

  Camshaft Position (CMP) sensor -G40-

  Injectors -N30-...-N33-, release cable guide

  Engine Coolant Temperature (ECT) sensor -G62-

  Engine speed (RPM) sensor -G28-

  Knock Sensor (KS) 1 -G61-

Knock Sensor (KS) 2 -G66-

Secondary Air Injection (AIR) pump motor -V101-

Oil pressure switch -F1-

if installed, A/C cut-out thermal switch -F163-

Mass Air Flow (MAF) sensor -G70-

Throttle valve control module -J338-

- Unbolt secondary air injection pump and bracket and remove.
- Disconnect all electric wires from transmission, Generator and starter and move clear.
- Disconnect all other electrical connections as necessary from engine and lay to one side.
- Unbolt pendulum support (arrows).

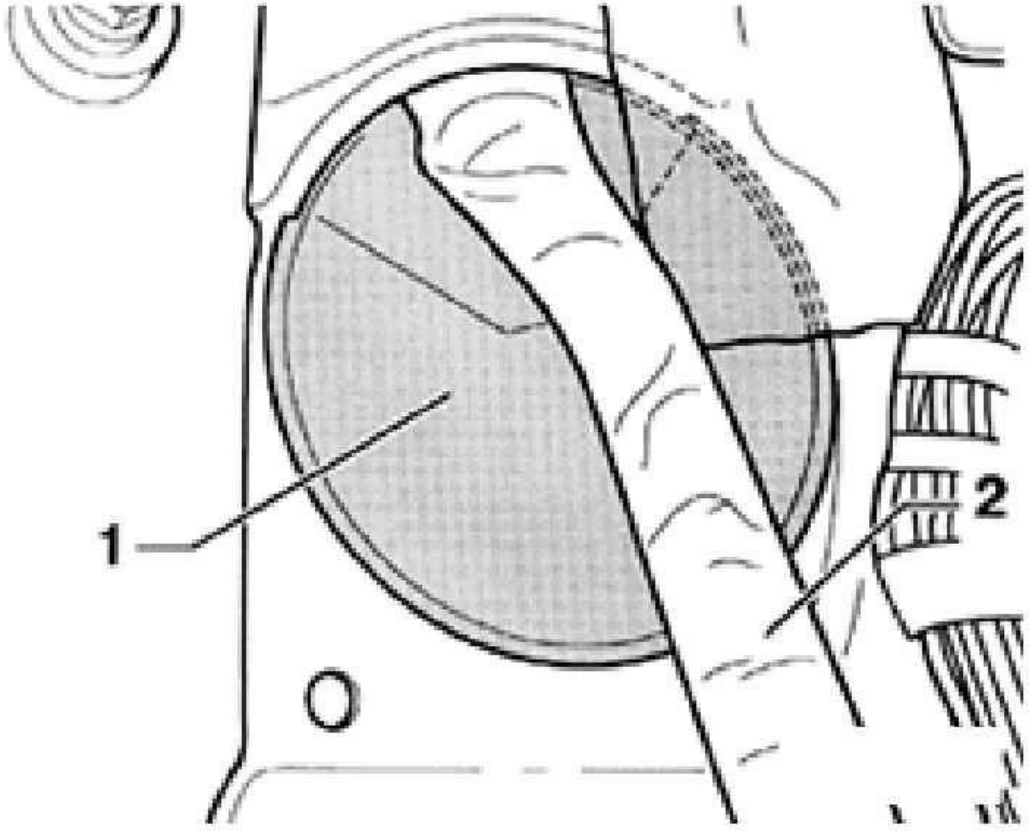


Fig. 8: Removing Pendulum Support Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove protective cover for right side inner constant velocity joint from engine.
- Remove right side axle shaft and disconnect left-hand drive shaft at transmission:

  See **FRONT AXLE SHAFT** .

- Remove front exhaust pipe. See **EXHAUST MANIFOLD, FRONT EXHAUST PIPE AND CATALYTIC CONVERTER WITH ATTACHMENTS** .
- Disconnect connection for oxygen sensor before catalytic converter (under vehicle floor).
- Remove oil sump protection. See **Fig. 138** .
- Insert engine bracket T 10012 in engine/transmission jack V.A.G 1383 A.
- Remove bracket on cylinder block for lower coolant hose. Threaded hole is required to secure engine bracket T10012.

- Secure engine bracket T10012 to front of cylinder block with securing bolt M10 x 25/ 8.8 to 40 N.m.

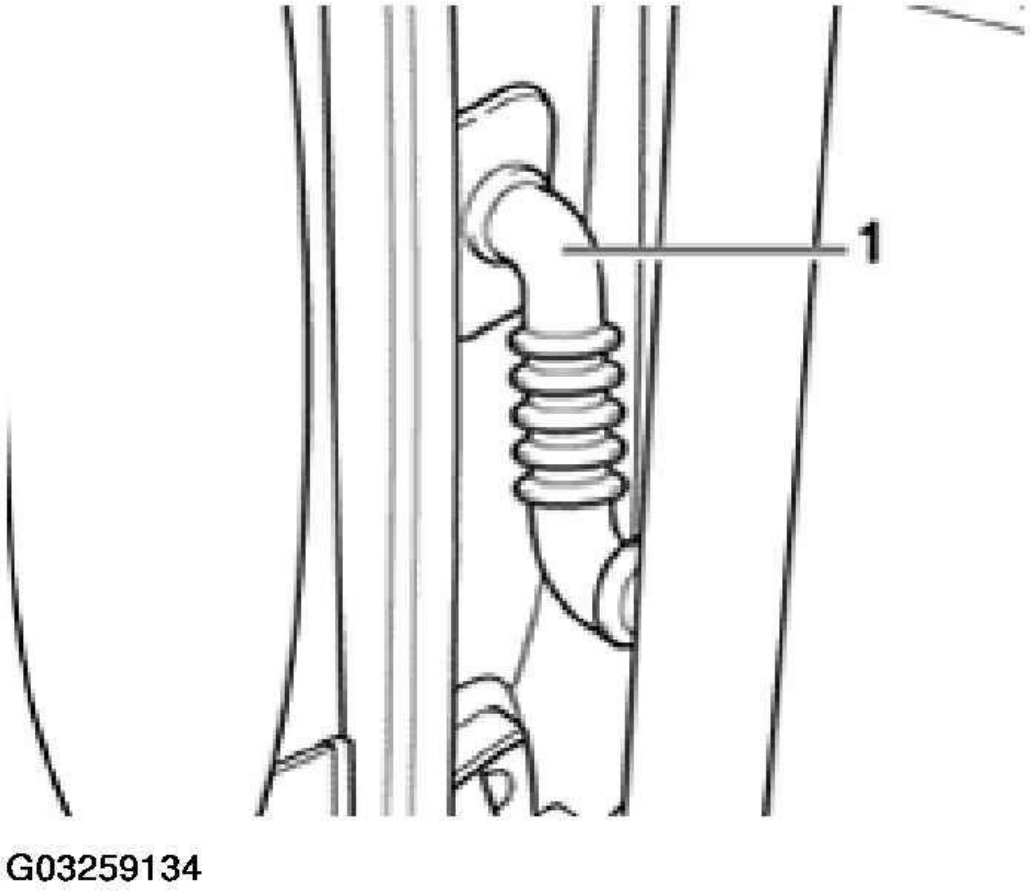


Fig. 9: Securing Engine Bracket To Front Of Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten securing nut on exhaust side hand tight.
- Lift engine and transmission lightly using engine/transmission jack V.A.G 1383 A.
- Unbolt engine side of assembly mounting from engine carrier at top (arrows).

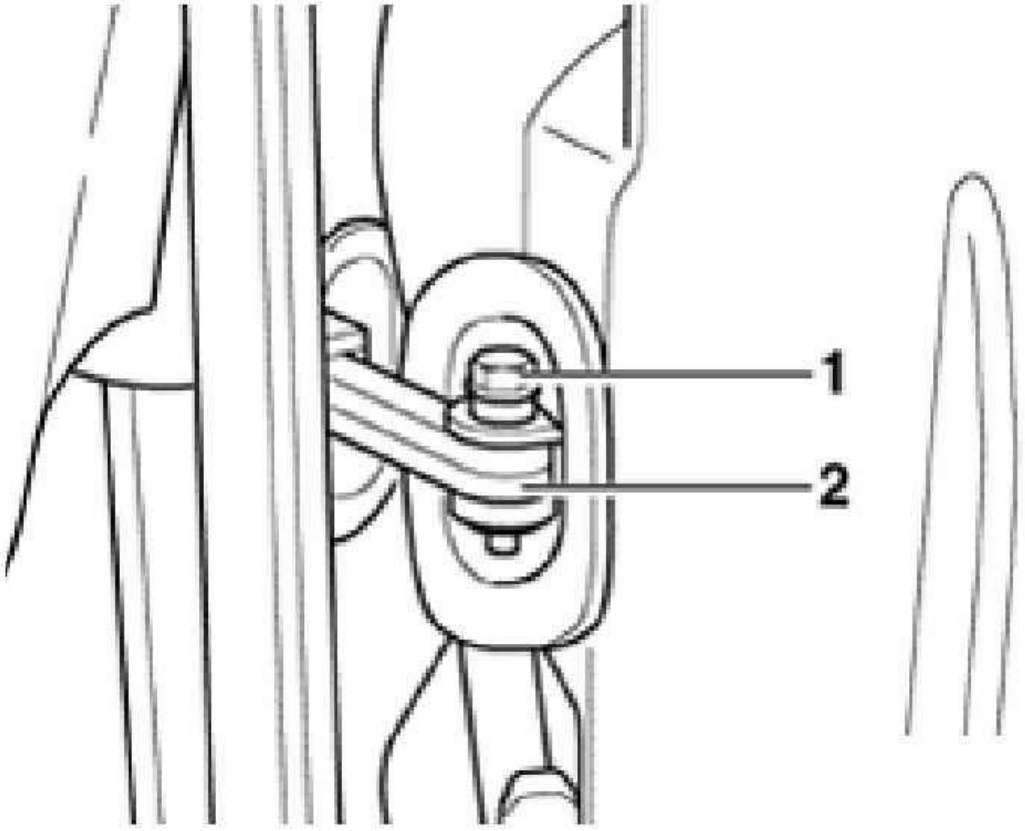


Fig. 10: Removing Engine Side Of Assembly Mounting Bolts From Engine Carrier At Top
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Use ladder VAS 5085 to remove securing bolts.

- Unbolt transmission side of assembly mounting from top of transmission carrier (arrows).

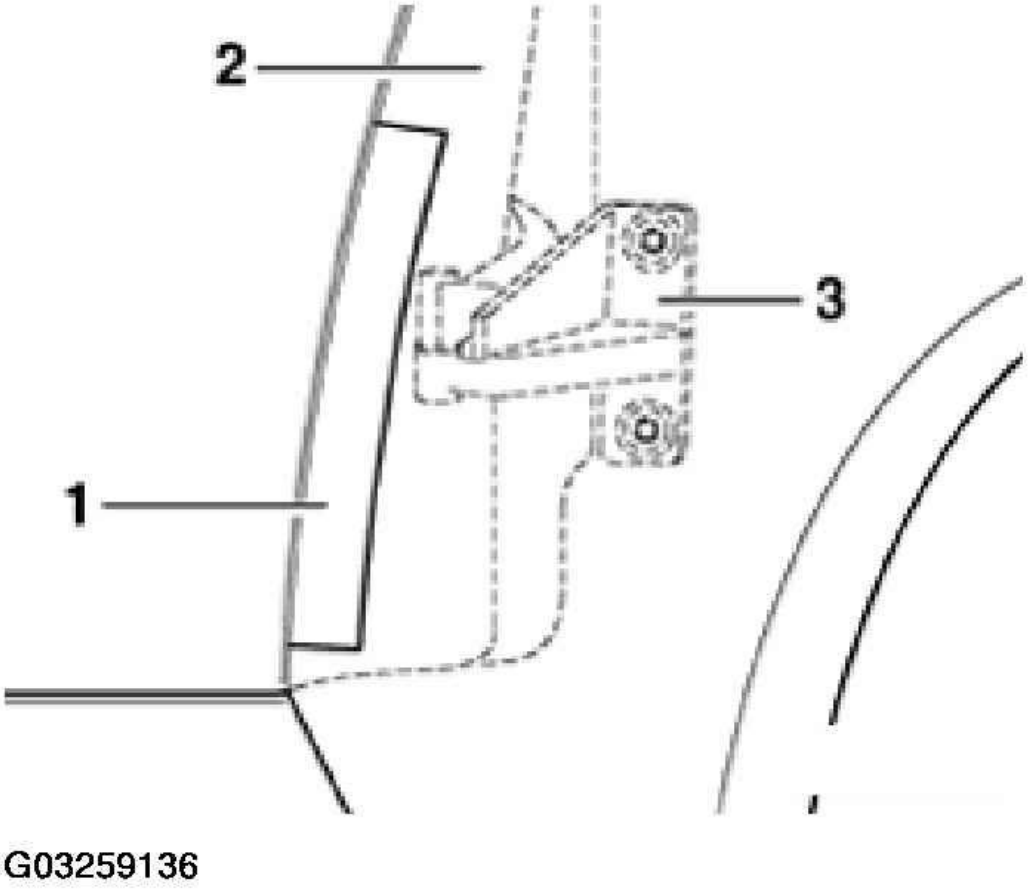


Fig. 11: Removing Transmission Side Of Assembly Mounting Bolts From Top Of Transmission Carrier
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully lower engine with transmission.
- While lowering engine guide power steering pressure line past transmission.

NOTE: Engine and transmission must be guided carefully when lowering to prevent damage to the bodywork, hoses and wiring.

Engine, mounting on assembly stand

When working on the engine, it should be secured to the assembly stand support clamp VW 313 using the engine and transmission bracket VW 540 and supplementary set VW 540/1B.

Work sequence

- Move engine/transmission assembly to a work bench with jack V.A.G 1383 A.

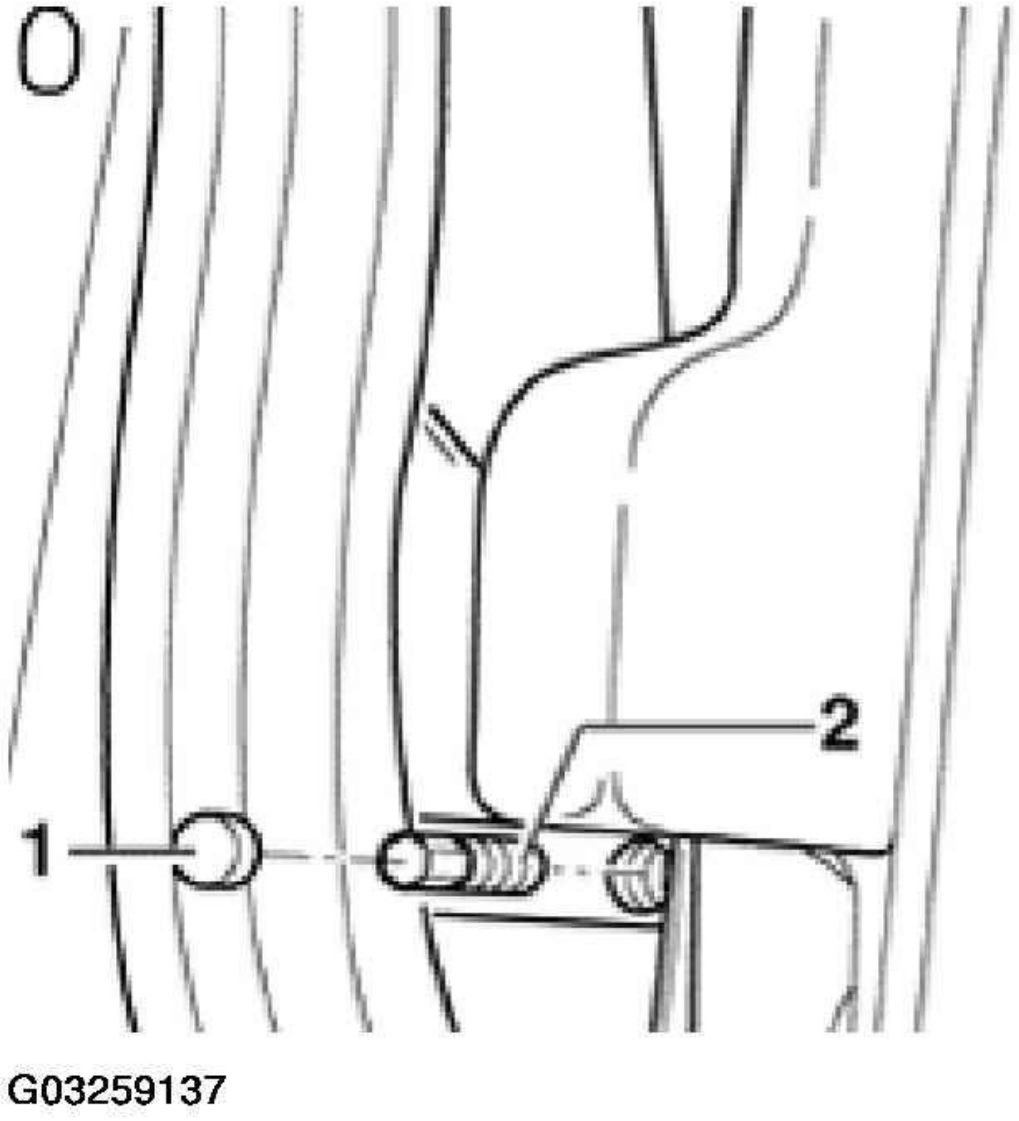


Fig. 12: Moving Engine/Transmission Assembly To Work Bench With Jack
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lower engine/transmission assembly so that transmission is on work bench.
- Remove engine/transmission connecting bolts.
- Press off transmission.

Continuation for all models

- Attach lifting tackle 2024 A as follows and lift off engine/transmission jack V.A.G 1383 A with workshop crane.

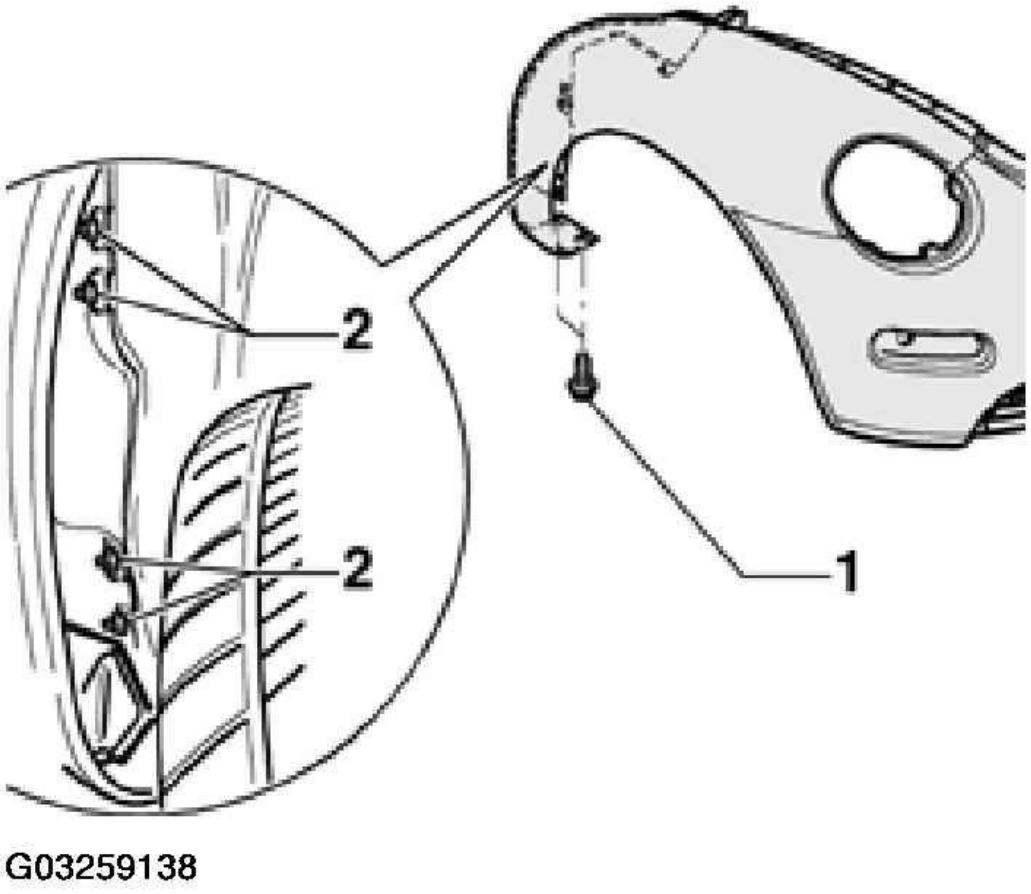


Fig. 13: Attaching Lifting Tackle To Engine Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Pulley end: 3rd hole of lifting rail in position 2

Flywheel end: 3rd hole of lifting rail in position 8

CAUTION: Hooks and locating pins must be secured with locking pins.

NOTE: Positions marked 1...4 on the bar must face toward belt pulley end. The holes in the hook rails are counted up from the hook.

- Secure engine to support clamp VW 313 using engine and transmission bracket VW 540 and supplementary set VW 540/1B. Dowel sleeves must be removed.

Engine installation notes

Installation is performed in the reverse sequence, Note the following.

WARNING: When performing repair work, especially due to the confined conditions in the engine compartment, pay attention to the following:

- **Route all types of lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum) as well as electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

- Insert new dowel sleeves in cylinder block for centralizing engine and transmission.
- Fit intermediate plate onto sealing flange and slide onto dowel sleeves (arrows).

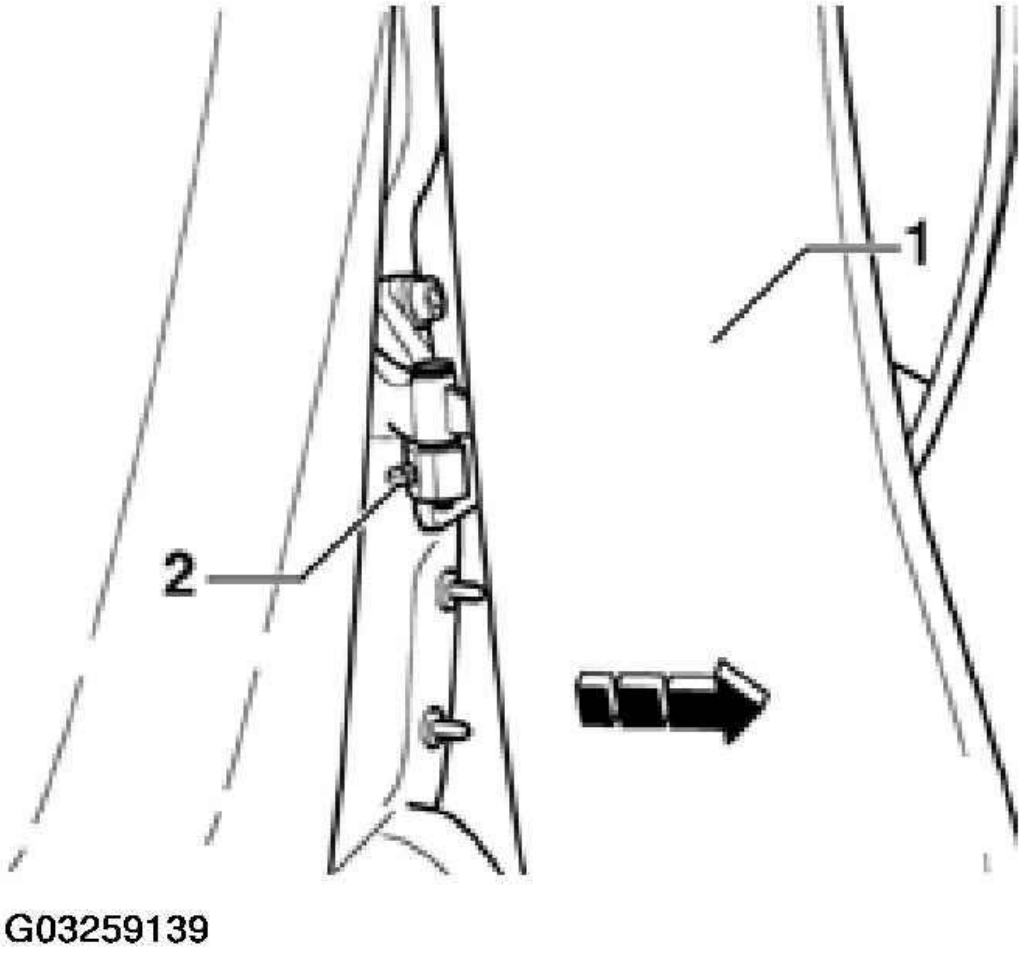


Fig. 14: Fitting Intermediate Plate Onto Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with manual transmission

- Lightly grease input shaft splines with G 000 100 grease.
- Check clutch and clutch operating mechanism, then install.

  See **CLUTCH ASSEMBLY** .

- Install gear shift mechanism, adjust gear shift cables if necessary:

  See **SELECTOR MECHANISM**

Vehicles with automatic transmission

- Install selector cable on transmission, adjust if necessary:

  For 01M transmission, see **SELECTOR LEVER CABLE** .

- Install selector cable on transmission, adjust if necessary:

  For 09G transmission, see **SELECTOR LEVER CABLE** .

NOTE: Always replace selector cable circlip

Vehicles with air conditioning

- Install air conditioning compressor:

  See **CONDENSER, REMOVING AND INSTALLING** .

Continuation for all models

- When installing engine/transmission assembly, ensure sufficient clearance to engine and transmission mountings and radiator.
- When doing this guide power steering pressure line past transmission.
- Align assembly mountings for engine and transmission. See **ENGINE AND TRANSMISSION MOUNTINGS, ALIGNING** .

NOTE: Torque settings. See ASSEMBLY MOUNTING .

- Install right side axle shaft and attach left side axle shaft to transmission.

  See **FRONT AXLE SHAFT** .

- Install front exhaust pipe. See **EXHAUST MANIFOLD, FRONT EXHAUST PIPE AND CATALYTIC CONVERTER WITH ATTACHMENTS** , Removing and installing parts of exhaust system.
- Install power steering pump:

  See **POWER STEERING PUMP, RESERVOIR, HYDRAULIC LINES**

- Reconnect electrical connections and check routing.
- Install ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Install secondary air injection pump.
- Install center, left and right insulation trays:

See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Fill system with coolant. See **COOLING SYSTEM, DRAINING AND FILLING**

Vehicles without EPC

- Adjust accelerator cable. See **ACCELERATOR CABLE, ADJUSTING** , servicing accelerator mechanism.

Vehicles with EPC

- Adapt (match) engine control module to throttle valve control. See**COMPONENTS AND FUNCTIONS, ADAPTING** , Adapt components and functions

Continuation for all models

- If fault memory has been erased or engine control module was disconnected from permanent positive, respective components must be adapted to engine control module. See **ENGINE CONTROL MODULE FAULT MEMORY, INTERROGATING AND ERASING** , and readiness code generated again.
- Road test vehicle and interrogate all fault memories:

  Observe the valid safety precautions when performing a road test. See **SAFETY PRECAUTIONS** .

- Read readiness code.

Vehicles with automatic transmission

- Adapt transmission control module:

  For 01M, see **BASIC SETTING, INITIATING**

  For 09G, see **BASIC SETTING, INITIATING**

- Test drive vehicle and interrogate fault memory.

Engine and transmission mountings, aligning

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 10-222 A Support assembly with legs 10-222 A/1 and Adapter 10-222 A/3

CAUTION: The assembly must be supported with support bar 10-222A before loosening bolts.

Locating Engine Mounting

Engine mounting

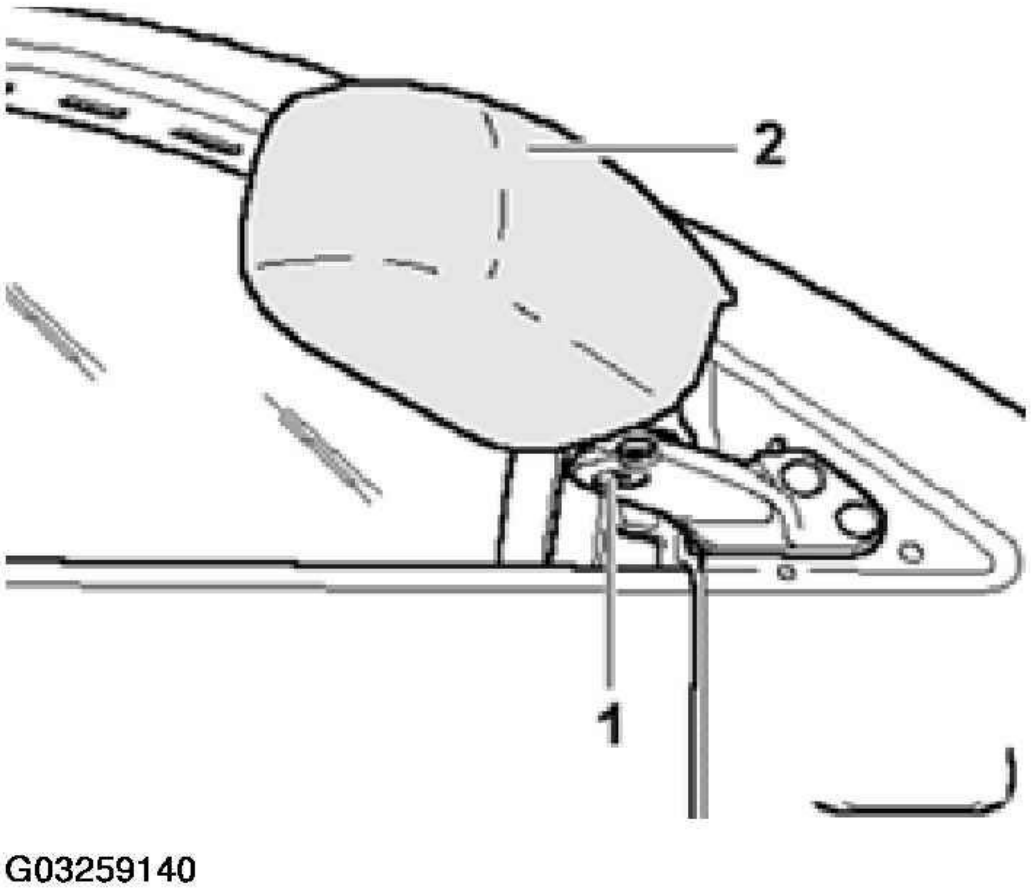


Fig. 15: Locating Engine Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

-a- = 14.0 mm

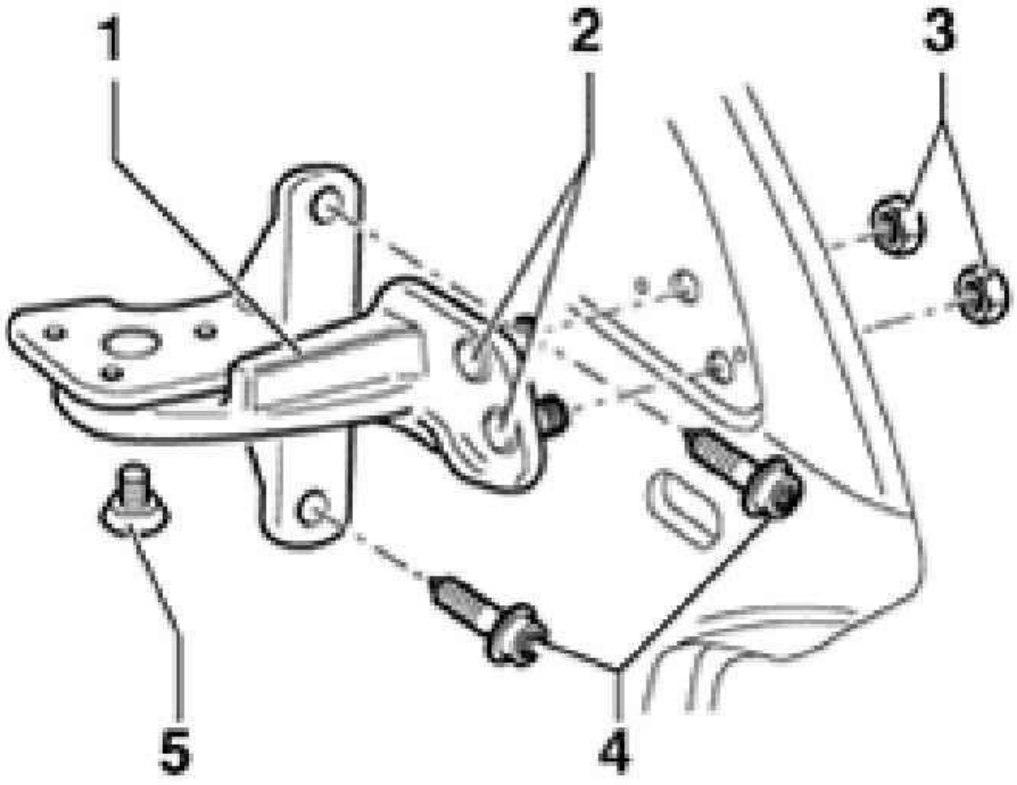
-b- = at least 10.0 mm

Both bolt heads 1 must be flush with edge -c-

Transmission mounting

Edges -a- and -b- must be parallel with one another

Locating Transmission Mounting



1 - Door hinge.

2 - Threaded stud.

3 - Nut (20 Nm + 90°).

4 - Bolt (20 Nm + 90°).

5 - Bolt (27 Nm).

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Fig. 16: Locating Transmission Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

-c- = 18...20 mm.

Torque settings. See **ASSEMBLY MOUNTING** , Assembly mountings.

Tightening torques

TORQUE SPECIFICATIONS

Bolted connections		**Torque setting**
Bolts, nuts(1)	M6	10 N.m
	M7	15 N.m
	M8	25 N.m
	M10	40 N.m
	M12	60 N.m
Torque converter to drive plate		(2)
Drive (axle) shaft		(3)

(1) Deviating from above: Engine to transmission connecting bolts. For 02J, see **TORQUE SPECIFICATIONS** . For 01M A/T, see **TORQUE SPECIFICATIONS** . For 09G, see **TORQUE SPECIFICATIONS** .

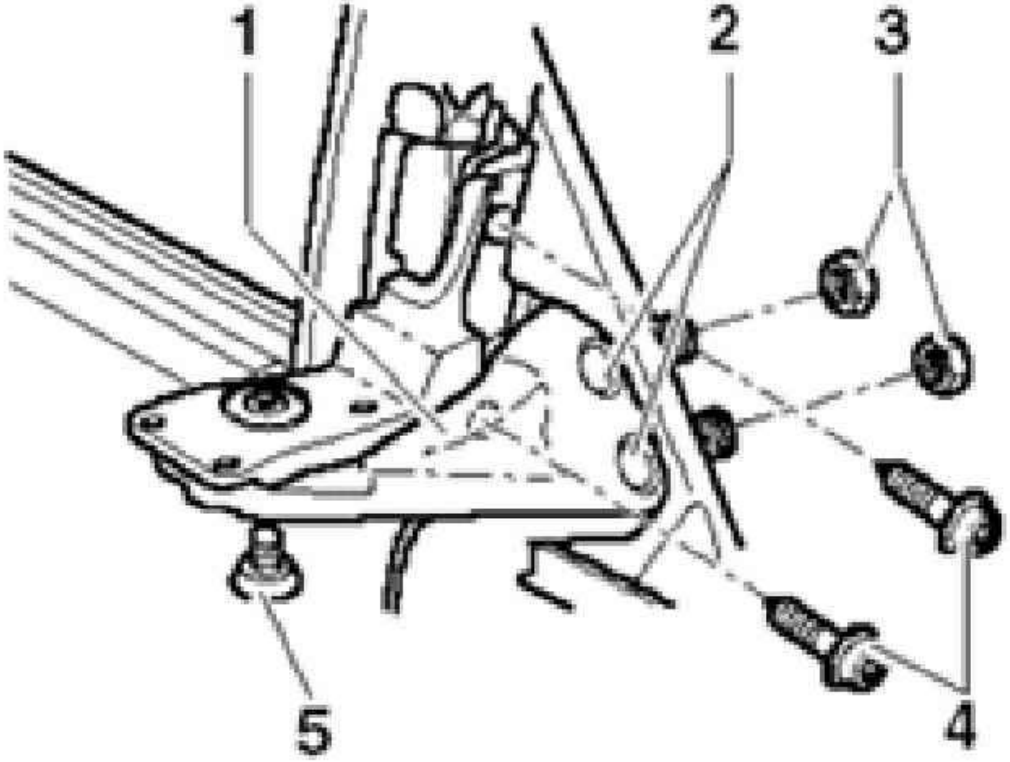
(2) For 01M, see **DRIVE PLATE** . For 09G, see either **DRIVE PLATE (1.8L)** or **DRIVE PLATE (2.0L)** .

(3) See **FRONT AXLE SHAFT** .

Assembly mounting

Tightening torques

Engine mounting



1 - Door hinge.

2 - Threaded stud.

3 - Nut (20 Nm + 90°).

4 - Bolt (20 Nm + 90°).

5 - Bolt (27 Nm).

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Fig. 17: Identifying Engine Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 17 .

1. Mounting to body

   40 N.m + 90°(1/4 turn)

   Replace bolts

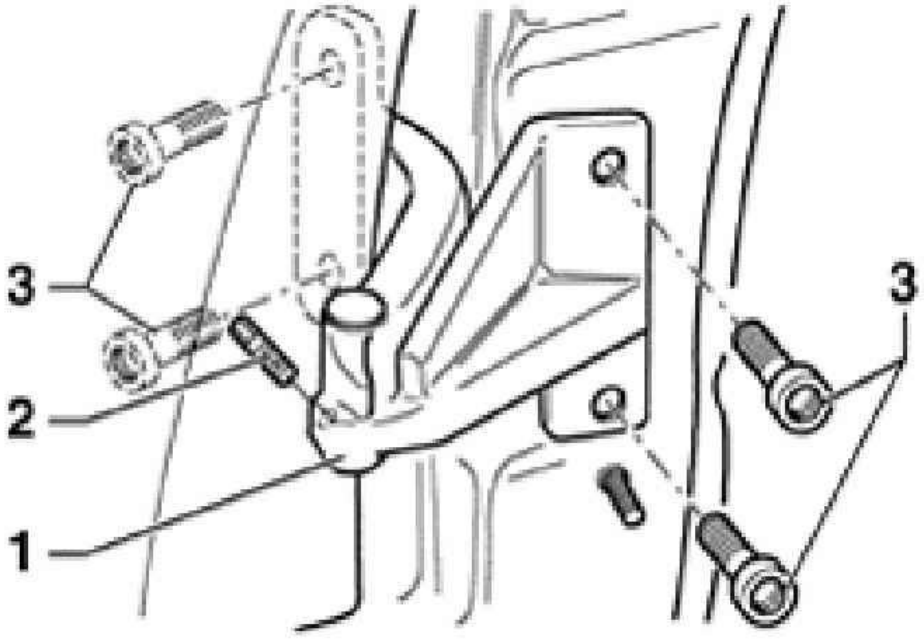
2. Mounting/bracket to body

   25 N.m

3. Mounting to engine mounting

   100 N.m

Transmission mounting



1 - Door hinge.

2 - Grub screw (13 Nm).

3 - Bolt (20 Nm + 90°).

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Fig. 18: Identifying Transmission Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 18 .

1. Mounting to body

   40N.m + 90° (1/4 turn)

   Replace bolts

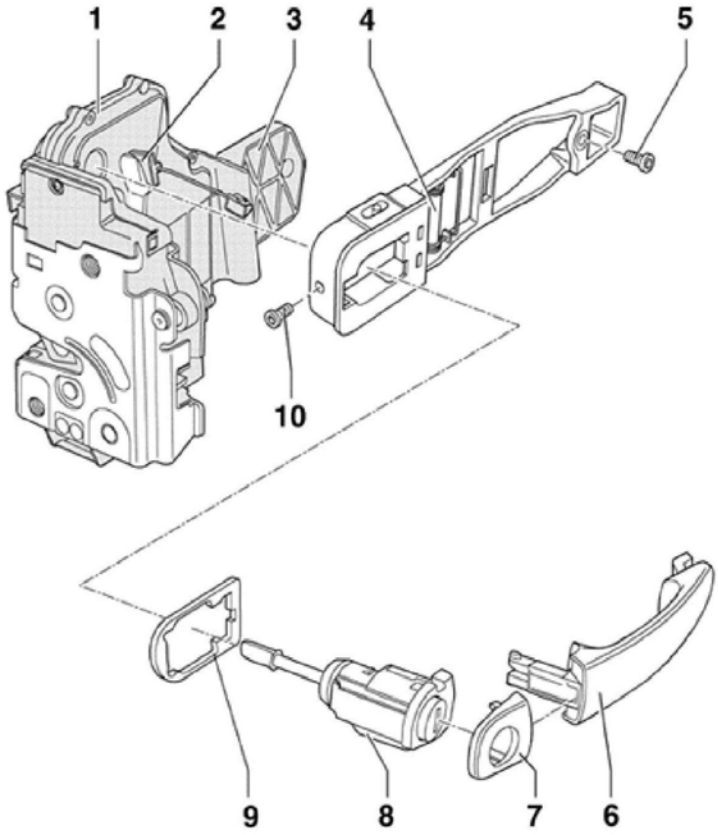
2. Mounting to body

   25 N.m

3. Mounting to transmission console

   100 N.m

Pendulum support



1 - Door lock
2 - Cable
3 - Retaining bracket
4 - Bearing bracket
5 - Multi-point socket head bolt
6 - Door handle
7 - Cover cap
8 - Lock cylinder housing
9 - Backing piece
10 - Multi-point socket head bolt

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Fig. 19: Identifying Pendulum Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 19 .

1. Pendulum support to transmission

   40 N.m + 90° (1/4 turn)

   Replace bolts

2. Pendulum support to transmission

   40 N.m + 90°(1/4 turn)

   Replace bolts

3. Pendulum support to subframe

   20 N.m + 90° (1/4 turn)

   Replace bolts

Additional information and assembly work on models with an air conditioning system

CAUTION: The air conditioning refrigerant circuit must not be opened.

NOTE: To prevent damage to the condenser as well as to the refrigerant lines/hoses, ensure that lines and hoses are not stretched, kinked or bent.

To facilitate removal and installation of the engine without having to open the refrigerant circuit:

- Remove retaining clamp(s) from refrigerant lines.
- Remove air conditioning compressor:

  See **CONDENSER, REMOVING AND INSTALLING** .

- Secure air conditioning compressor to towing eye so that refrigerant lines/hoses are not under tension.

  NOTE: Protect bumper with tape to prevent damage.

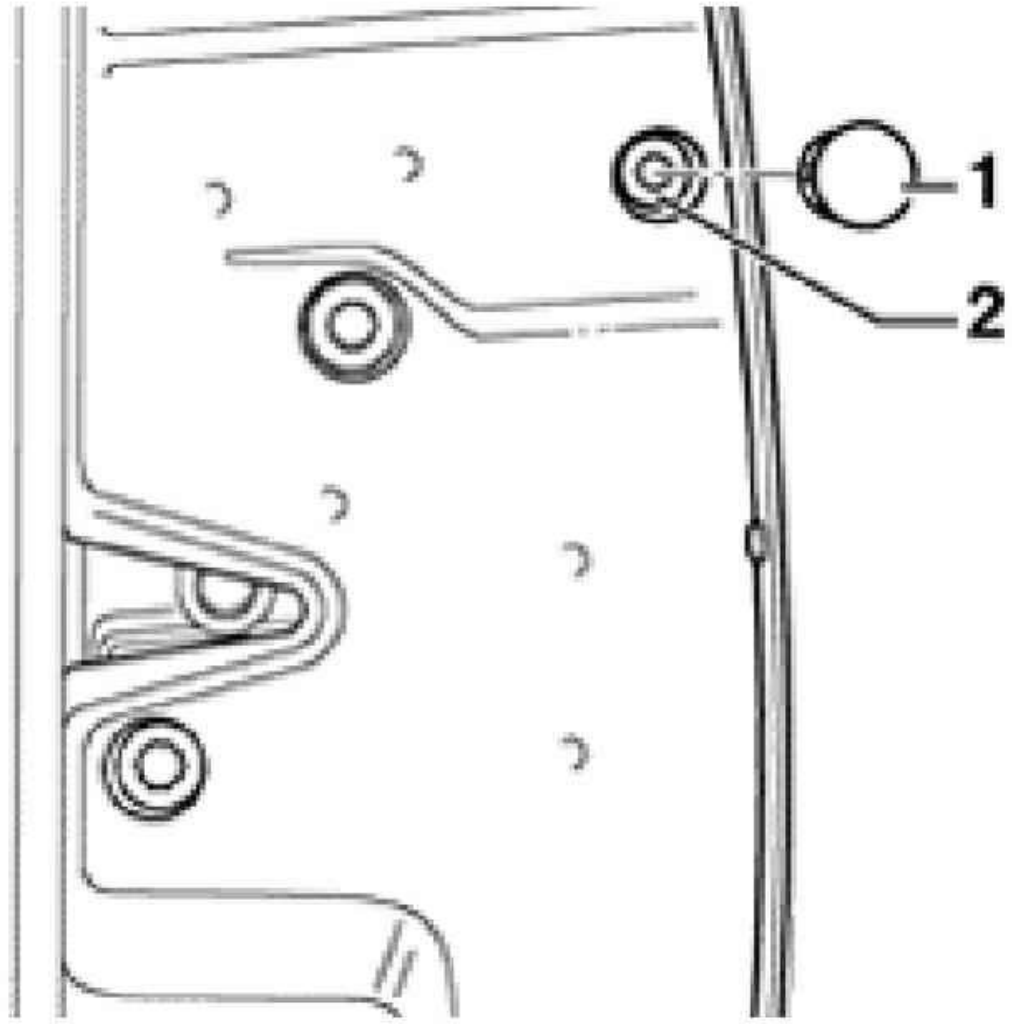

Fig. 20: Securing Air Conditioning Compressor To Towing Eye
Courtesy of VOLKSWAGEN OF AMERICA, INC.

ENGINE - CRANKSHAFT, CYLINDER BLOCK

ENGINE, DISASSEMBLING AND ASSEMBLING

NOTE: **If when repairing an engine, metal shavings or large amounts of small metal particles are found in the engine oil, caused for example by partial seizure of**

crankshaft or conrod bearings. Perform the following work sequences to prevent consequential damage once repairs are complete:

- **Thoroughly clean oil passages**
- **Replace oil spray jets**
- **Replace oil cooler**
- **Replace oil filter**

Only engine codes BDC, BGD

- The balancer shaft gear assembly must be adjusted. See **OIL PUMP WITH BALANCER SHAFT GEAR ASSEMBLY, REMOVING AND INSTALLING** .

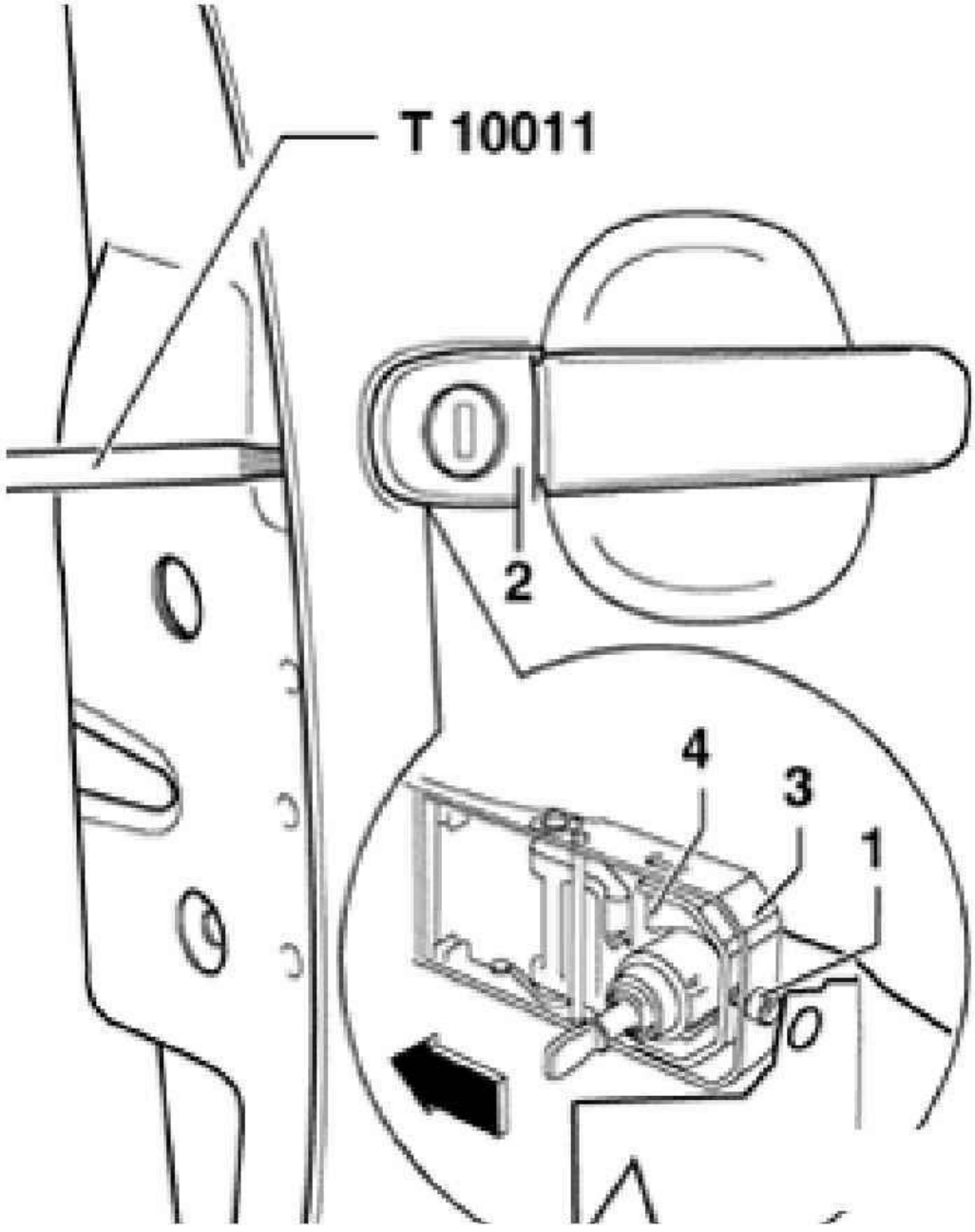

Fig. 21: Disassembling And Assembling Engine (Parts I & II)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

I. See **PART I**

II. See **PART II**

Part I

NOTE: The following list refers to items in Fig. 22 .

1. **45 N.m**
2. **Engine bracket**
3. **25 N.m**
4. **Retainer**
   - According to engine versions
5. **Retainer**
   - According to engine versions
6. **Clamp**
7. **10 N.m**
   - For engine cover
   - According to engine versions
8. **20 N.m**
   - According to engine versions
9. **Toothed belt guard-upper part**
10. **Toothed belt guard, center section**
11. **20 N.m**
12. **Washer**
13. **Tensioner**
    - Checking semiautomatic toothed belt tensioning roller. See **SEMI-AUTOMATIC TOOTHED BELT TENSIONING ROLLER, CHECKING** .
14. **Toothed belt**
    - Mark direction of rotation before removing
    - Check for wear
    - Do not kink
    - Removing, installing and tensioning. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING**
15. **Rear toothed belt guard**
16. **Washer**
17. **O-ring**
    - Replace
18. **Coolant pump**
    - Check for ease of movement

- If damaged or leaking renew complete
- Removing and installing. See **COOLANT PUMP, REMOVING AND INSTALLING** .

19. **15 N.m**
20. **Crankshaft toothed belt sprocket**
21. **90 N.m + 1/4 turn (90°) further**
    - Replace
    - Threads and shoulder must be free of oil and grease
    - Use counter support tool 3415 to loosen and tighten
22. **Toothed belt guard, lower part**
23. **10 N.m**
    - Replace
24. **Clutch**
    - For air conditioning compressor
25. **Belt pulley**
    - For power steering pump
26. **Ribbed belt**
    - Mark direction of rotation before removing
    - Check for wear
    - Do not kink
    - Removing and installing. See **RIBBED BELT, REMOVING AND INSTALLING** .
27. **Belt pulley/vibration damper**
    - Can only be installed in one position. Holes are offset
    - Note position when installing toothed (timing) belt. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .
28. **25 N.m**
29. **Tensioning element for ribbed belt**
    - Turn with open end wrench to loosen ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .

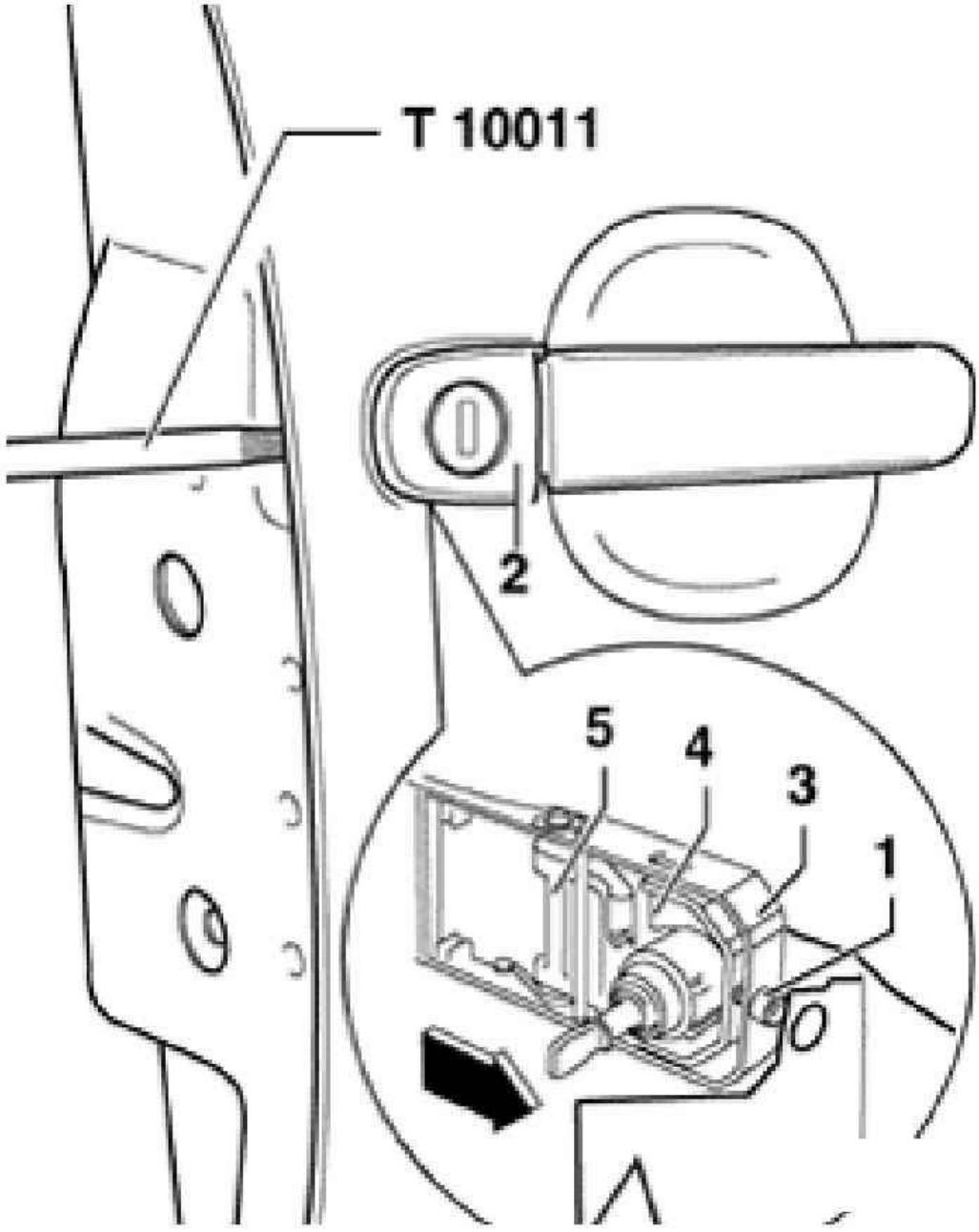

Fig. 22: Exploded View - Front Of Engine Components (Part I)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part II

NOTE: The following list refers to items in Fig. 23 .

1. **Knock Sensor (KS) 1 -G61-**
   - Gold plated contacts
2. **Connector**
   - For KS 1 -G61-
   - Gold plated contacts
   - Do not interchange

   See appropriate System Wiring Diagram article
3. **20 N.m**
   - Torque setting influences function of knock sensor
4. **Connector**
   - For KS 2 -G66-
   - Gold plated contacts
   - Do not interchange

   See appropriate System Wiring Diagram article
5. **Knock Sensor (KS) 2 -G66-**
   - Gold plated contacts
6. **Dipstick guide**
7. **Dipstick**
   - The oil level must not exceed the max. mark!
   - Markings. See **Fig. 136**
8. **Coolant pipe**
   - According to engine versions
   - Coolant hose connection diagram. See **COOLANT HOSE CONNECTION DIAGRAM** .
9. **25 N.m**
10. **Retainer**
    - For ignition coil
11. **Retainer**
    - According to engine versions
12. **10 N.m**
13. **Retainer**
    - According to engine versions

14. **Retainer**
    - According to engine versions
15. **Retainer**
    - According to engine versions
16. **Oil filter bracket**
    - Disassembling and assembling. See **Part II (Oil filter housing, disassembling and assembling)** .
17. **15 N.m + 1/4 turn (90°) further**
    - Replace
18. **Seal**
    - Replace
19. **Oil filter**
    - Loosen with strap wrench
    - Tighten by hand
    - Note instructions on filter when installing
20. **25 N.m**
21. **Oil cooler**
    - Coat contact surfaces to oil filter bracket outside the seal with AMV 188 100 02
    - Ensure clearance to adjacent components. See note at beginning of **ENGINE, DISASSEMBLING AND ASSEMBLING** .
22. **Seal**
    - Replace
23. **Engine speed sensor**
24. **Seal**
    - Replace if damaged
25. **40 N.m**
26. **Connecting unions**
27. **15 N.m**
28. **Coolant thermostat**
    - Checking: Heat up thermostat in water
    - Starts to open at approx. 86° C
    - Opening stroke: min. 7 mm
    - Removing and installing. See **THERMOSTAT, REMOVING AND INSTALLING** .
29. **Hex socket head bolt**
    - Torque setting:

      See **CONDENSER, REMOVING AND INSTALLING** .

30. **Compact bracket**

- For ribbed belt tensioning roller, Generator, power steering pump and air conditioning compressor

  See **CONDENSER, REMOVING AND INSTALLING** .

31. **Cylinder block**
    - Removing and installing sealing flange and flywheel/drive plate. See **SEALING FLANGES AND FLYWHEEL/DRIVE PLATE, REMOVING AND INSTALLING** .
    - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING** .
    - Disassembling and assembling piston and conrod. See **PISTON AND CONNECTING ROD, DISASSEMBLING AND ASSEMBLING** .
    - Engine codes BDC, BGD: Removing and installing oil pump with balancer shaft gear assembly. See **OIL PUMP WITH BALANCER SHAFT GEAR ASSEMBLY, REMOVING AND INSTALLING** .

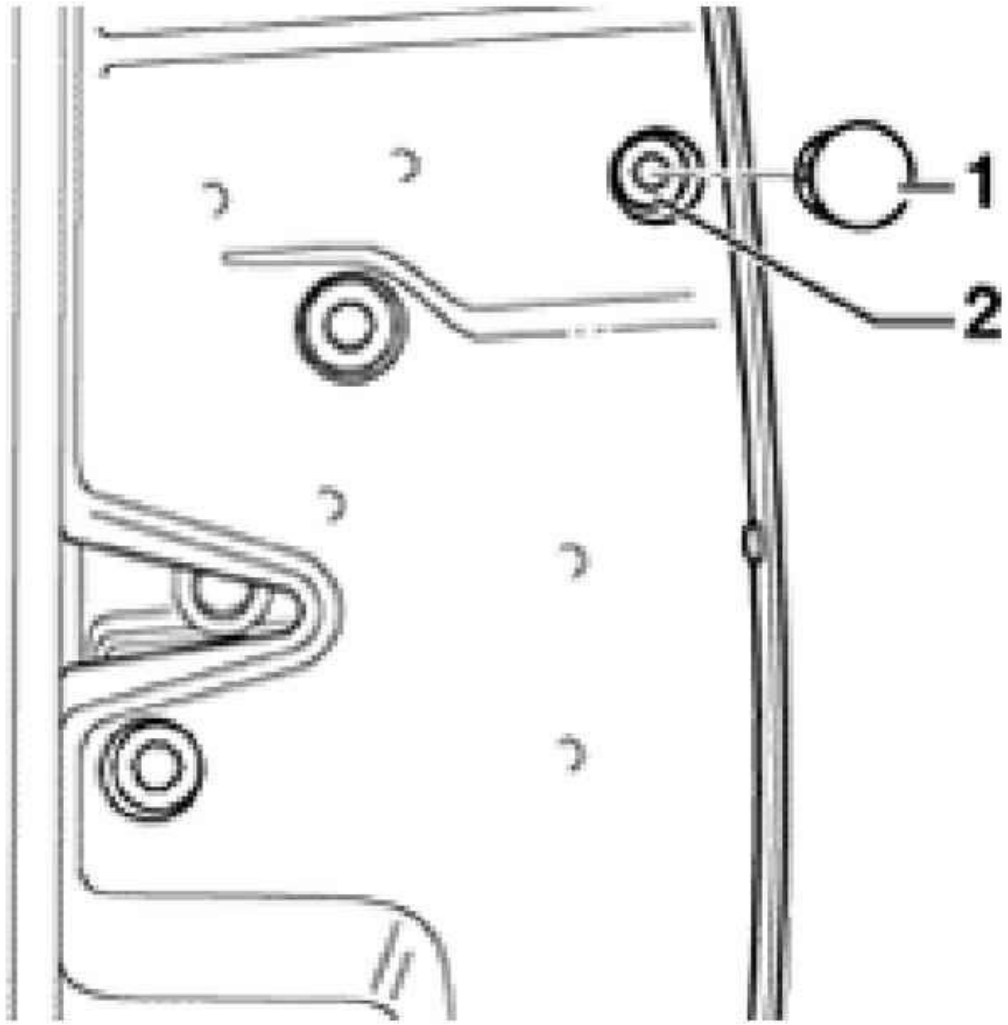

Fig. 23: Exploded View - External Engine Block Components (Part II)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Ribbed belt, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- T20167 Locking pin

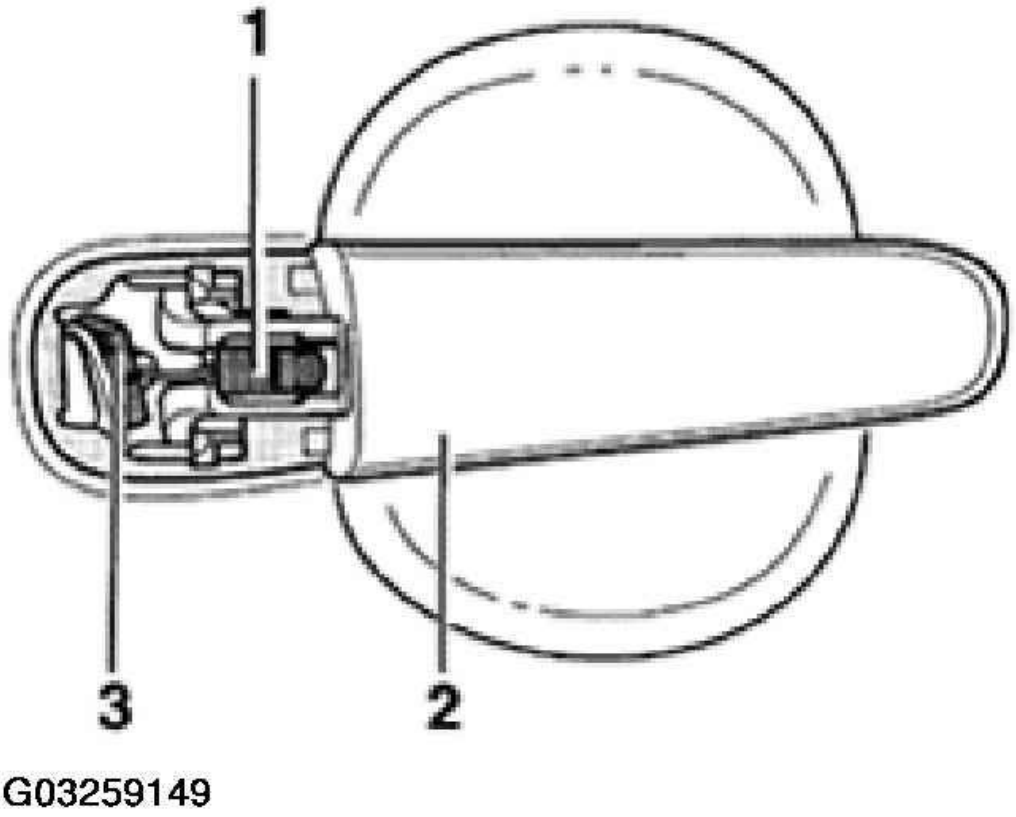

Fig. 24: Identifying Special Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove right side insulation tray:

  See **NOISE INSULATION, ASSEMBLY OVERVIEW** .

- Remove engine cover.
- Mark direction of rotation of ribbed belt.
- Turn tensioning device in direction of arrow to relieve tension on ribbed belt.

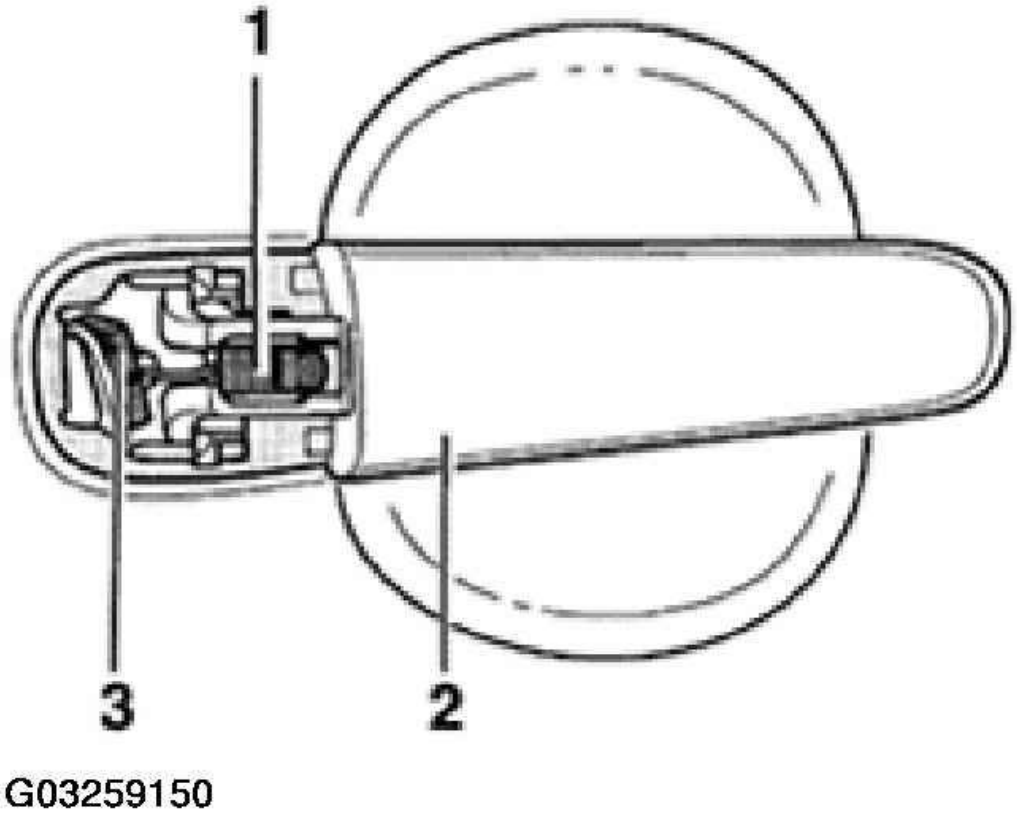

Fig. 25: Relieving Tension On Ribbed (Drive) Belt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lock tensioning element using locking pin T20167

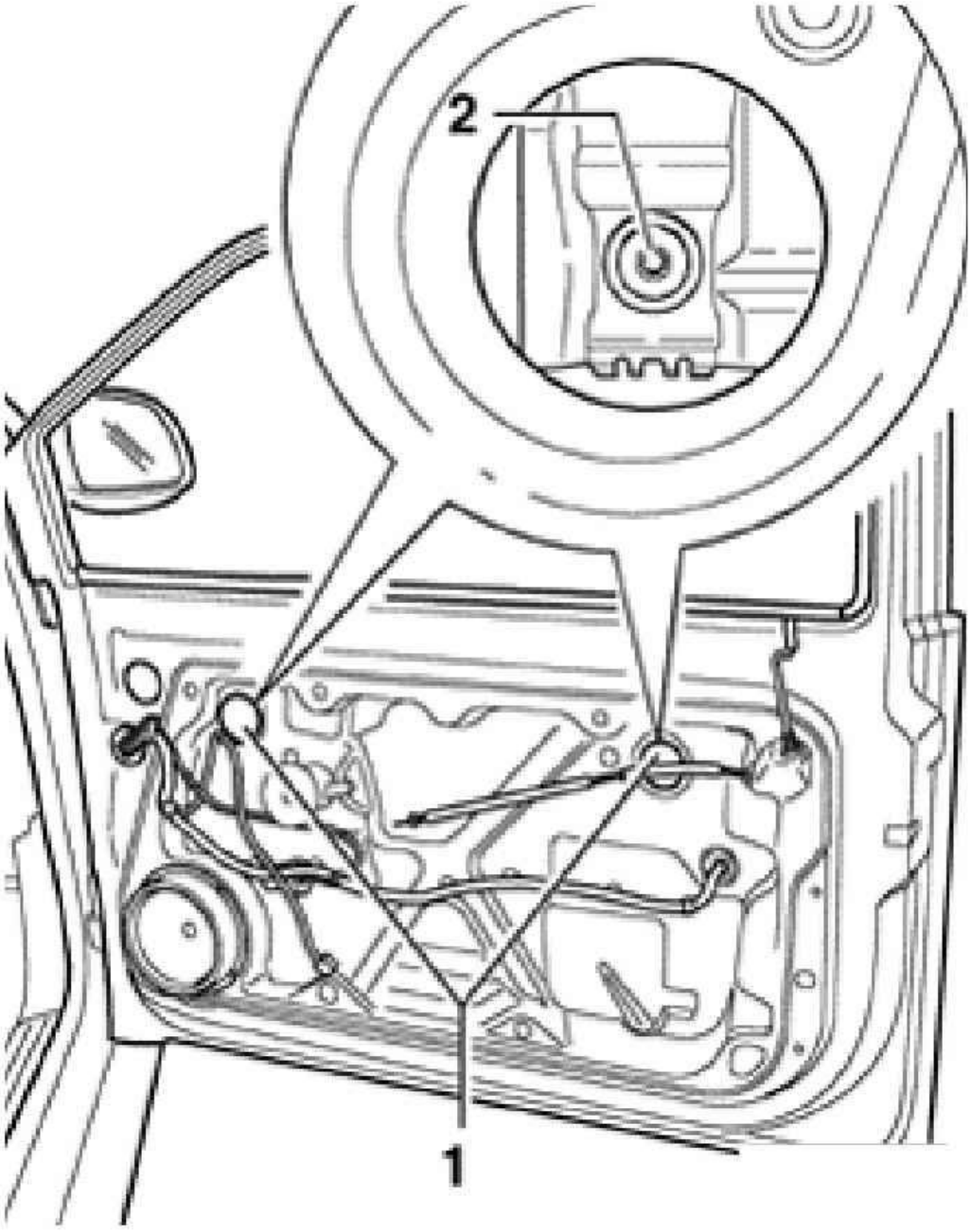

Fig. 26: Locking Ribbed (Drive) Belt Tensioning Element
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove ribbed belt.

Installing

- Install in reverse order.

NOTE:

- **Ensure, before installing ribbed belt, that all ancillaries (Generator, air conditioning compressor, power steering pump) are secured tightly.**
- **When installing the ribbed belt observe belt direction of rotation and that the belt is seated correctly in the belt pulleys.**
- **On models which do not have an air conditioning system place the ribbed belt over the Generator pulley last.**
- **For models with an air conditioning system place the ribbed belt over the air conditioning compressor last.**

After completing repairs always:

- Start engine and check belt running.

Belt drive without air conditioning compressor

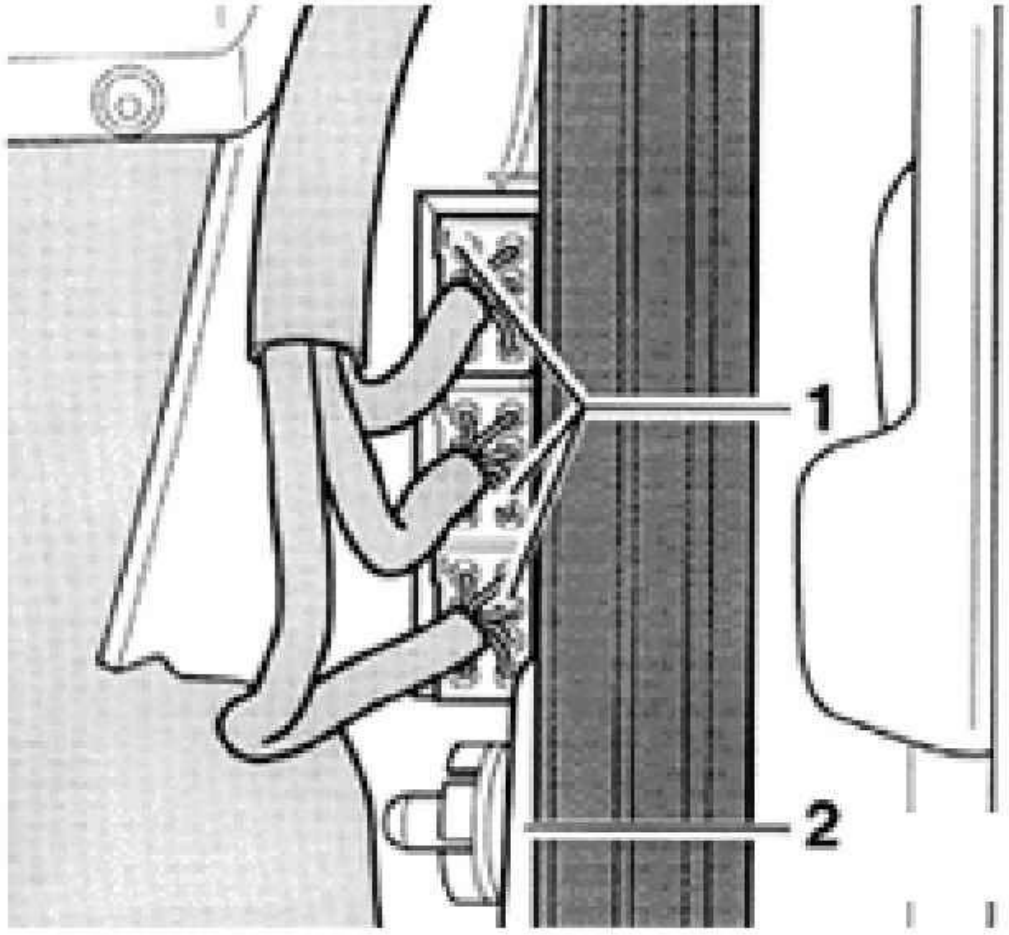

Fig. 27: Identifying Belt Drive Without Air Conditioning Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Belt drive with air conditioning compressor

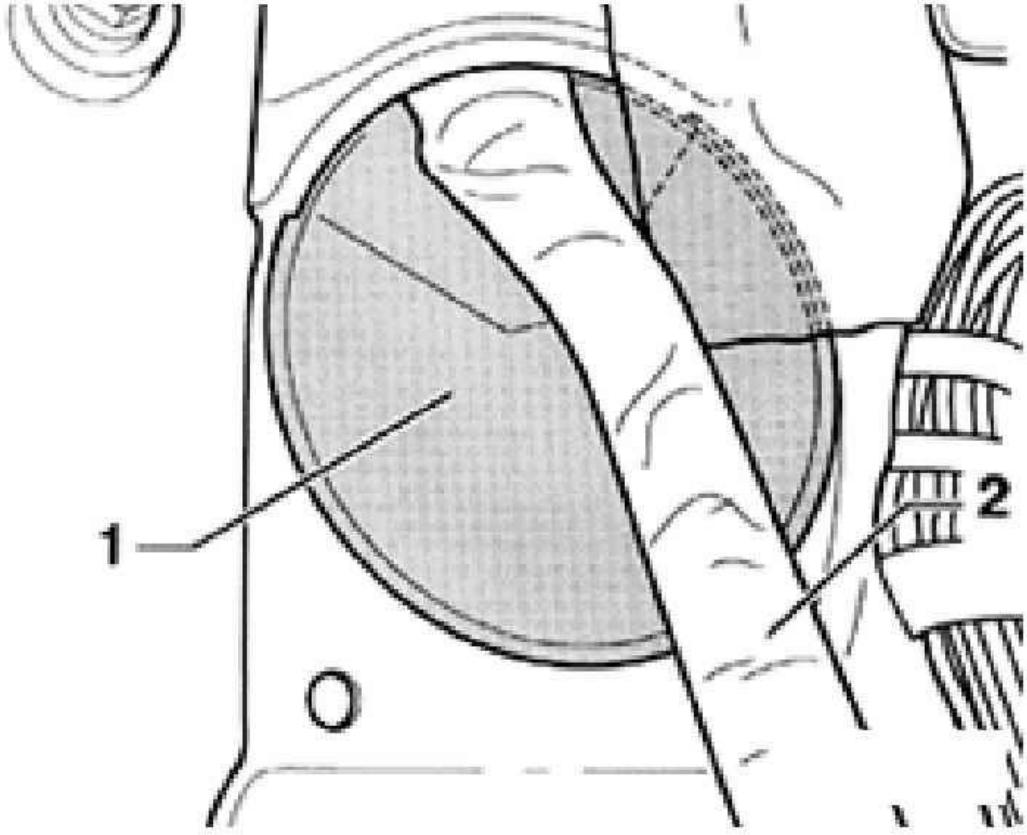

Fig. 28: Identifying Belt Drive With Air Conditioning Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

SEALING FLANGES AND FLYWHEEL/DRIVE PLATE, REMOVING AND INSTALLING

Engine codes AEG, AVH, AZG, BEV

NOTE: The following list refers to items in Fig. 29 .

1. **90 N.m + 1/4 turn (90°) further**
   - Replace
   - Threads and shoulder must be free of oil and grease
   - Use counterhold tool 3415 to loosen and tighten
2. **Crankshaft toothed belt sprocket**

3. **15 N.m**
4. **Seal**

   PTFE sealing rings:

   - Do not additionally oil or grease oil seal sealing lip

     Coil spring seals:

   - Oil or grease lightly oil seal sealing lip

     NOTE: Differences between PTFE sealing ring and coil spring seals. See Fig. 31 .

   - Replace. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING** .
5. **Sealing flange**
   - Remove oil sump to remove and install
   - Must be located on dowel sleeves
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
6. **Cylinder block**
   - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING** .
   - Disassembling and assembling piston and connecting rod. See **PISTON AND CONNECTING ROD, DISASSEMBLING AND ASSEMBLING** .
7. **60 N.m + 1/4 turn (90°) further**
   - Replace
8. **Flywheel/drive plate**
   - To remove and install flywheel counter-hold with 3067
   - Removing and installing drive plate. See **DRIVE PLATE, REMOVING AND INSTALLING** .
9. **Intermediate plate**
   - Must be located on dowel sleeves. See **Fig. 32** .
   - Do not damage/bend when assembling
10. **Sealing flange with oil seal**
    - Only replace complete
    - Use protective sleeve supplied when installing
    - Remove oil sump to remove and install
    - Before installing, remove oil remains from crankshaft journal with a clean cloth.
    - Remove protective sleeve first after sealing flange has been slid onto crankshaft journal

PTFE sealing rings:

- Do not additionally oil or grease oil seal sealing lip

Coil spring seals:

- Oil or grease lightly the seal sealing lip
- Differences between PTFE sealing ring and coil spring seals. See **Fig. 31** .

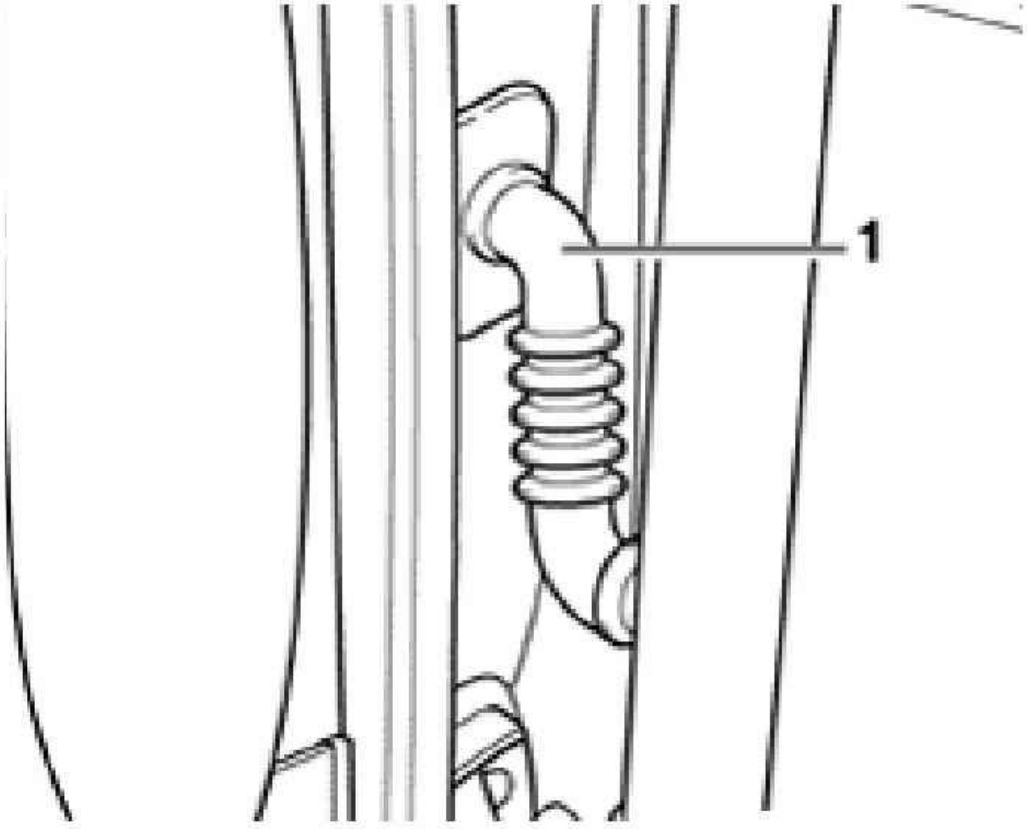

Fig. 29: Sealing Flanges & Flywheel/Drive Plate (Engine Codes AEG, AVH, AZG, BEV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine codes BDC, BGD

NOTE: The following list refers to items in Fig. 30 .

1. **90 N.m + 1/4 turn (90°) further**
   - Replace
   - Threads and shoulder must be free of oil and grease
   - Use counter support tool 3415 to loosen and tighten
2. **Crankshaft toothed belt sprocket**
3. **15 N.m**
4. **Seal**

   PTFE sealing rings:
   - Do not additionally oil or grease oil seal sealing lip

   Coil spring seals:
   - Oil or grease lightly the seal sealing lip
   - Differences between PTFE sealing ring and coil spring seals, see **Fig. 31** .
   - Replacing. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING** .
5. **Sealing flange**
   - Remove oil sump to remove and install
   - Must be seated on dowel sleeves
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
6. **Cylinder block**
   - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING** .
   - Disassembling and assembling piston and connecting rod. See **PISTON AND CONNECTING ROD, DISASSEMBLING AND ASSEMBLING** .
7. **60 N.m + 1/4 turn (90°) further**
   - Replace
8. **Flywheel/drive plate**
   - Counter support with 3067 when removing and installing flywheel
   - Removing and installing drive plate. See **DRIVE PLATE, REMOVING AND INSTALLING** .
9. **Intermediate plate**
   - Must be located on dowel sleeves. See **Fig. 32** .
   - Do not damage/bend when assembling
10. **Sealing flange with oil seal**
    - Only replace complete
    - Use protective sleeve supplied when installing

- Remove oil sump to remove and install
- Before installing, remove oil remains from crankshaft journal with a clean cloth.
- Remove protective sleeve first after sealing flange has been slid onto crankshaft journal
- PTFE sealing rings: Do not additionally oil or grease oil seal sealing lip
- Coil spring seals: Oil or grease lightly the seal sealing lip
- Differences between PTFE sealing ring and coil spring seals. See **Fig. 31**

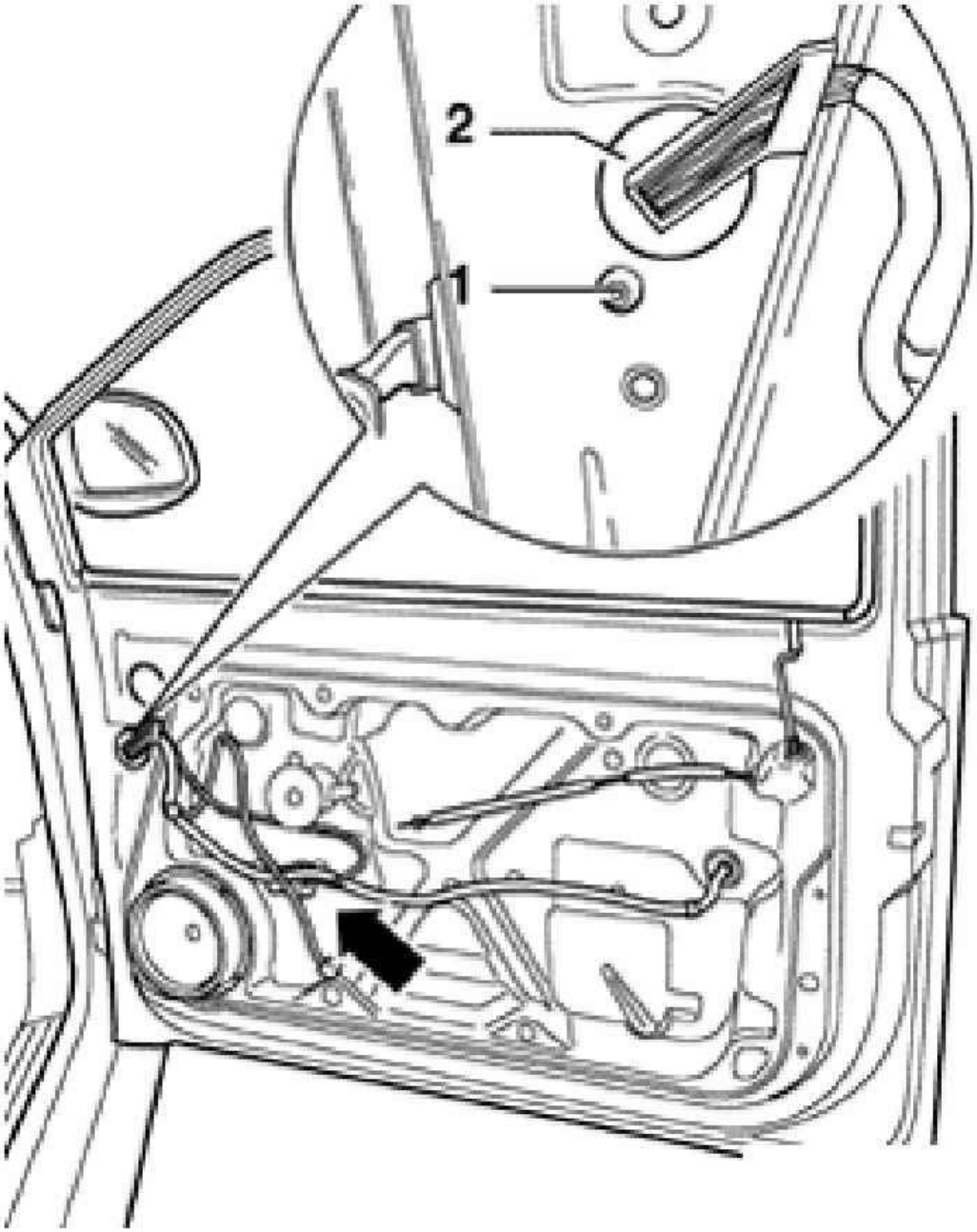

Fig. 30: Sealing Flanges And Flywheel/Drive Plate (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Differences Between Sealing Rings

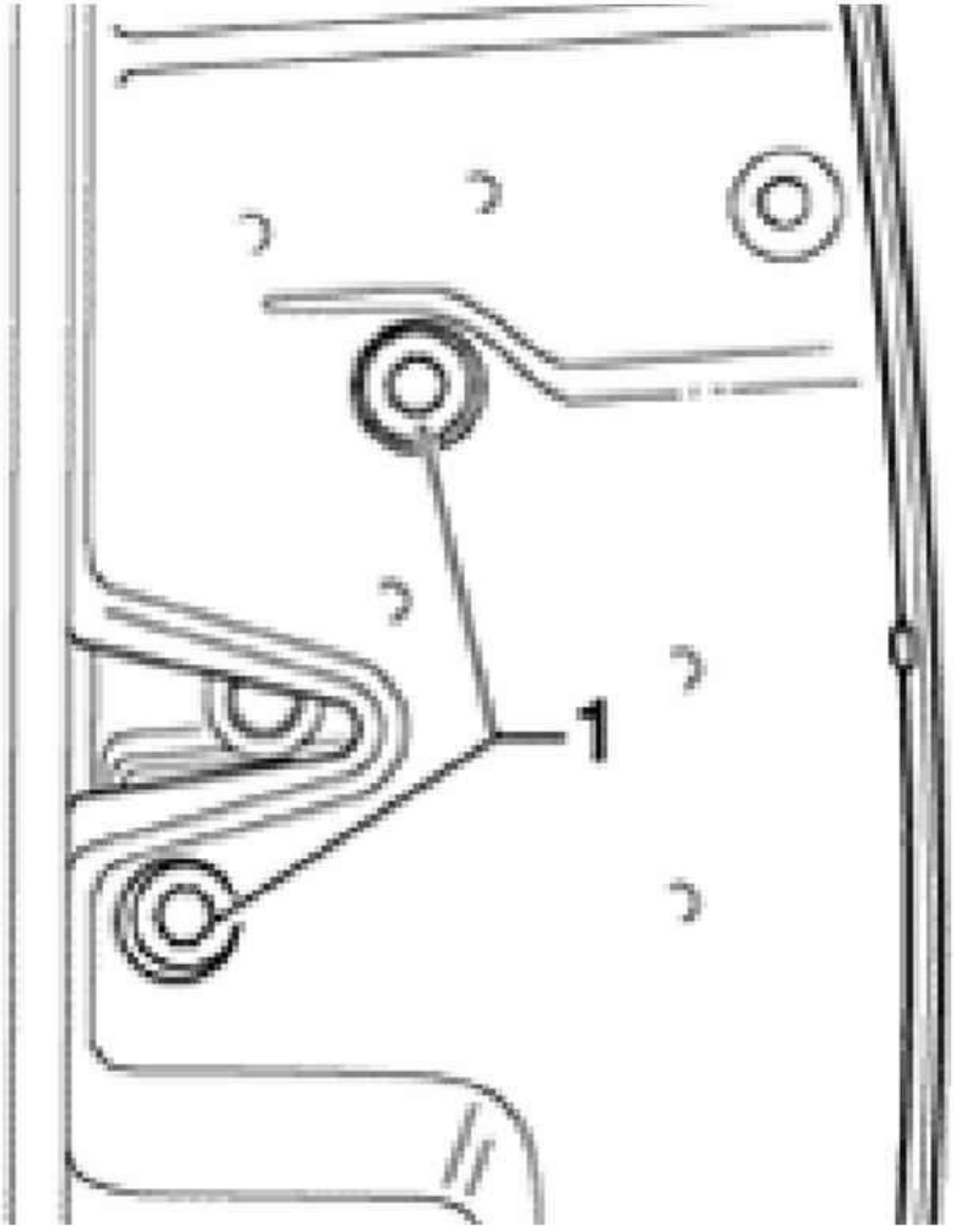

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Fig. 31: Identifying Differences Between Sealing Rings
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **For clarity reasons, individual sealing rings for sealing flange are also shown. Only replace sealing flange complete with oil seal.**
- **A PTFE seal (Teflon) -2- is gradually being introduced instead of the inner coil spring seal -1-. This has a wider sealing lip.**
- **PTFE oil seals are installed free of oil and grease.**
- **A radial shaft seal of older design (with annular spring) may be replaced with a PTFE oil seal, but not vice versa.**
- **When a PTFE seal is installed, then only such a seal may be installed as a replacement part!**

Installation position of intermediate plate

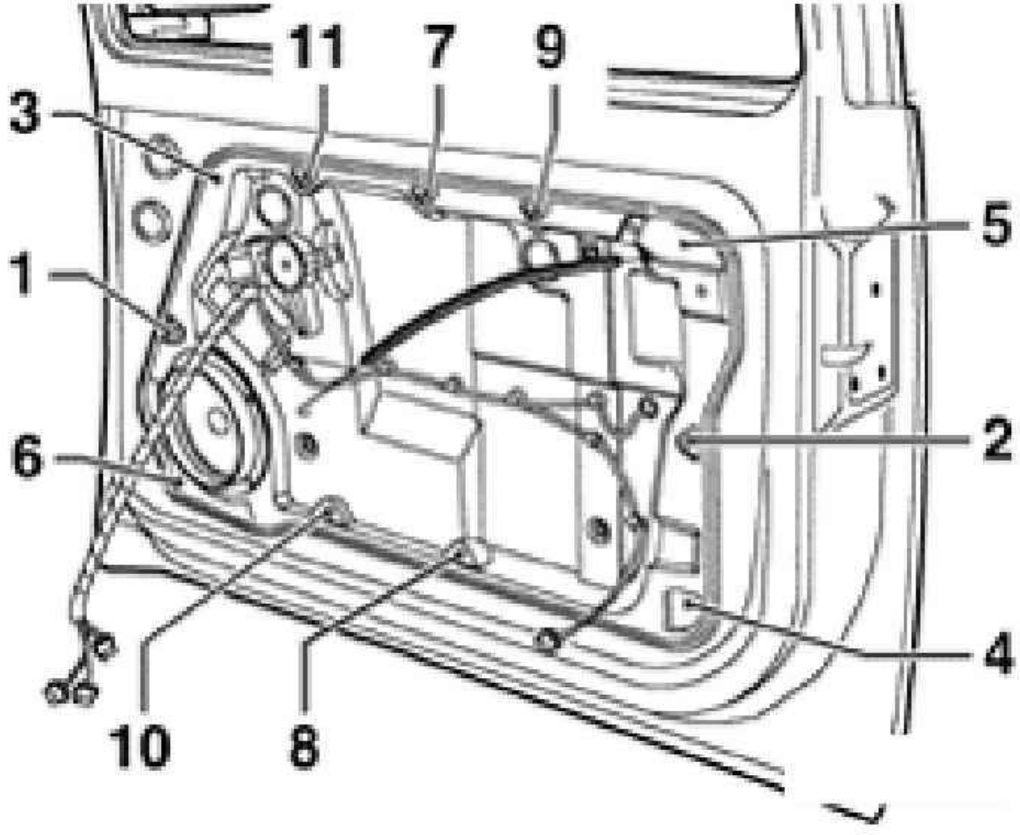

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Fig. 32: Installing Intermediate Plate Onto Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install intermediate plate onto sealing flange and slide onto dowel sleeves (arrows).

Crankshaft oil seal - pulley end, replacing

Special tools, equipment, testers, measuring instruments and auxiliary items required

For coil spring seals:

- 2080 A Fitting sleeve
- 3203 Oil seal extractor
- 3266 Fitting sleeve
- 3415 Counterhold
- V.A.G 1331 Torque wrench (5 ... 50 N.m)
- V.A.G 1332 Torque wrench (40 ... 200 N.m)

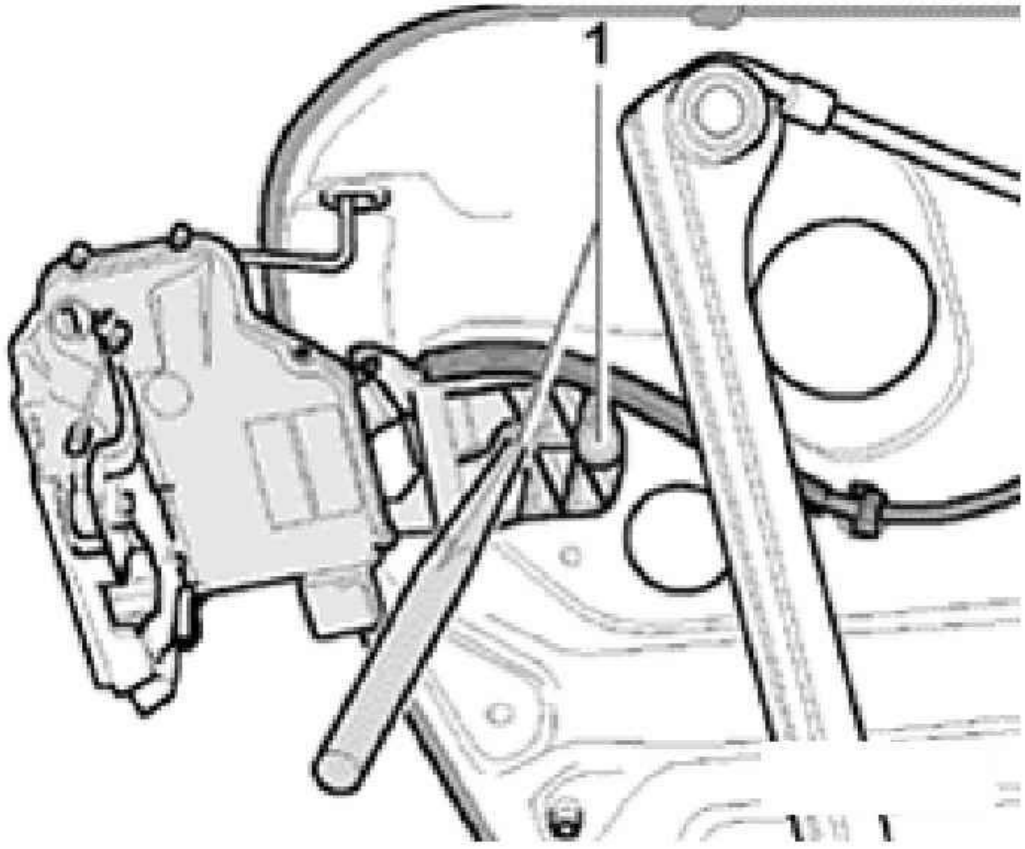

Fig. 33: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

For PTFE seals:

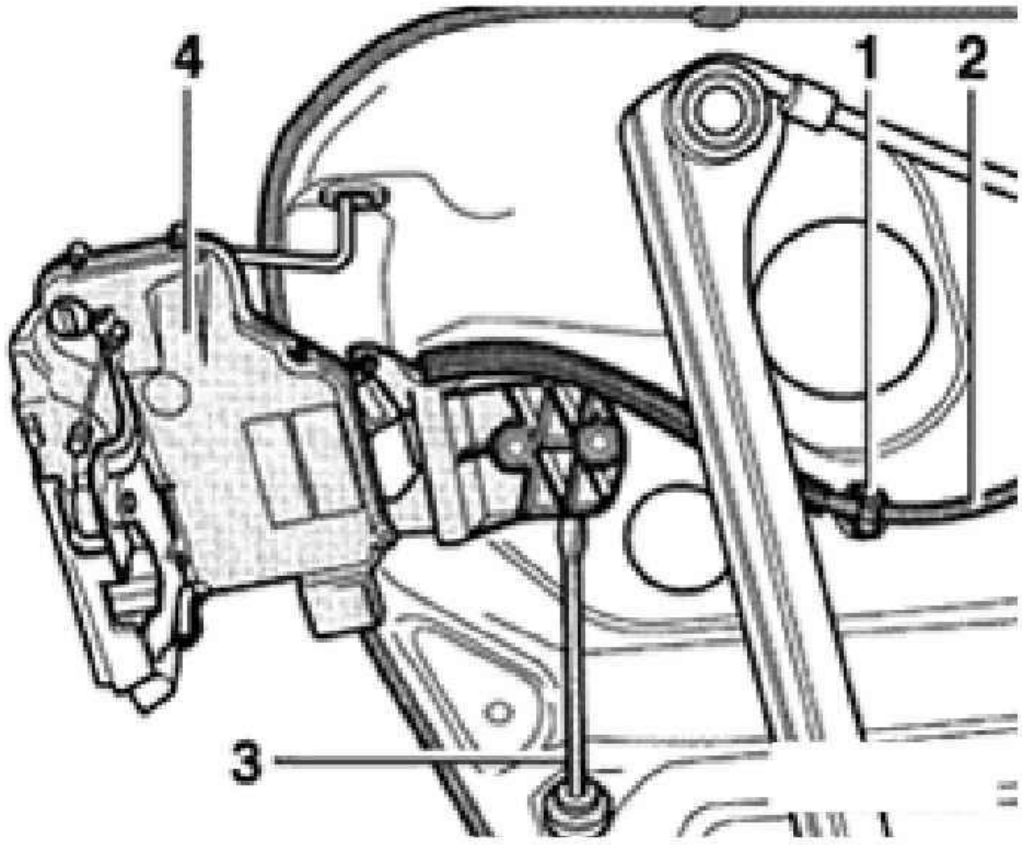

Fig. 34: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- 3203 Oil seal extractor
- 3415 Counter support
- T10053 Assembly device
- V.A.G 1331 Torque wrench (5...50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)

Removing

- Remove ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Remove toothed (timing) belt. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .

- Remove crankshaft toothed belt pulley. To do this counter support sprocket with 3415.

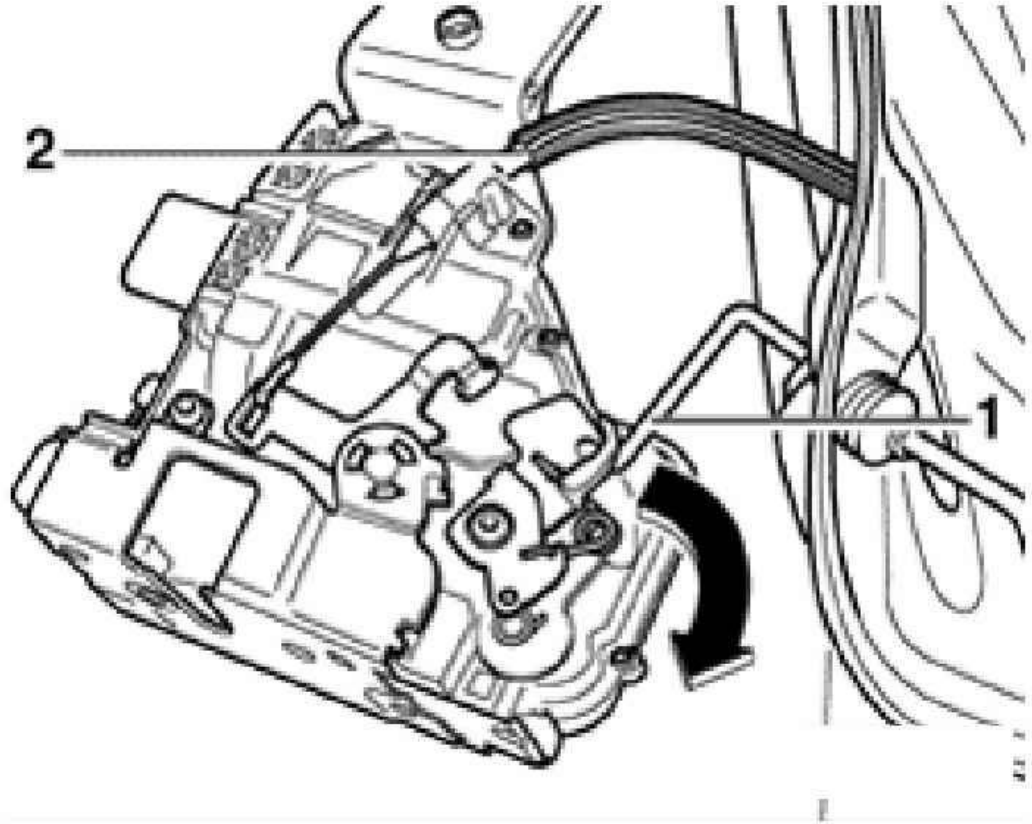

Fig. 35: Removing Crankshaft Toothed Belt Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- To guide seal extractor, thread center bolt into crankshaft onto limit stop by hand.

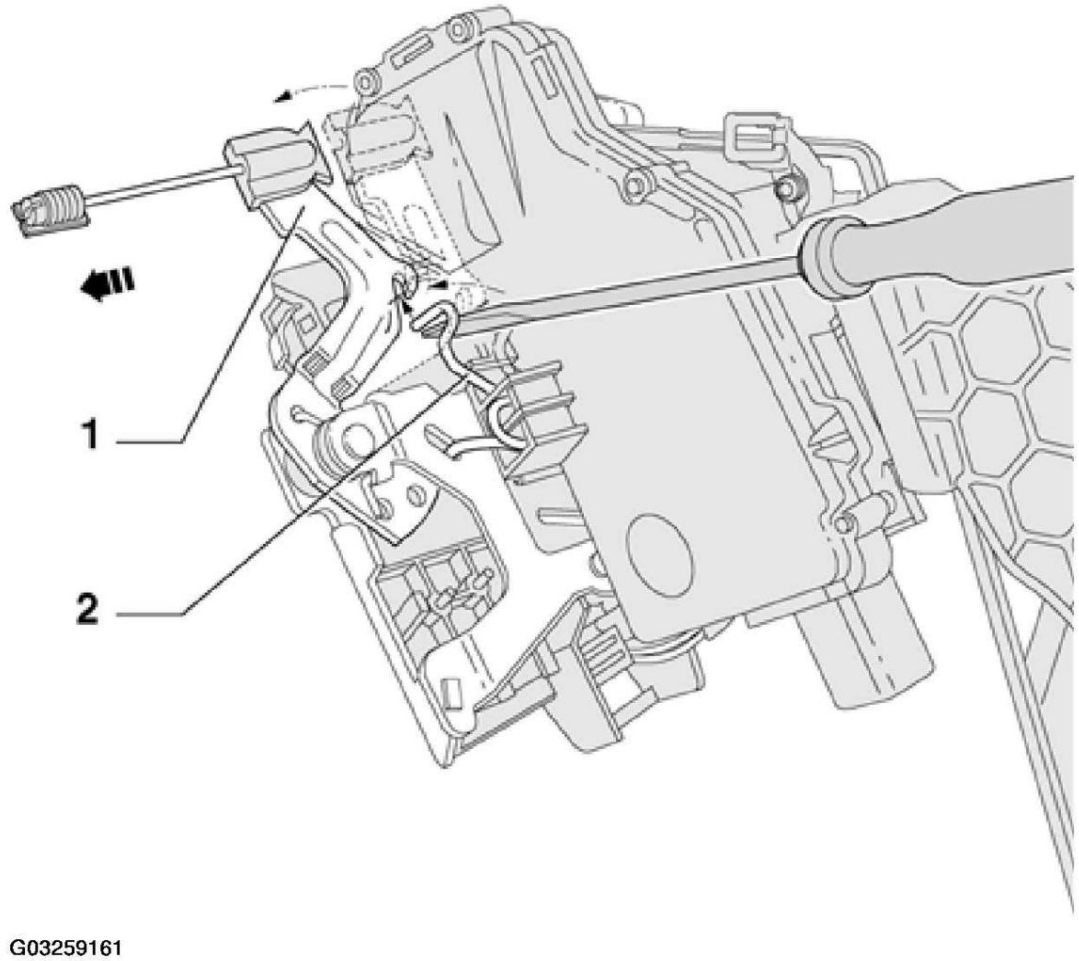

Fig. 36: Installing Bolt Into Crankshaft
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unscrew inner part of oil seal extractor 3203 nine turns (approx. 20 mm) out of outer part and lock with knurled screw.
- Lubricate threaded head of oil seal extractor 3203, place it in position and exerting firm pressure screw it as far as possible into oil seal.
- Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.

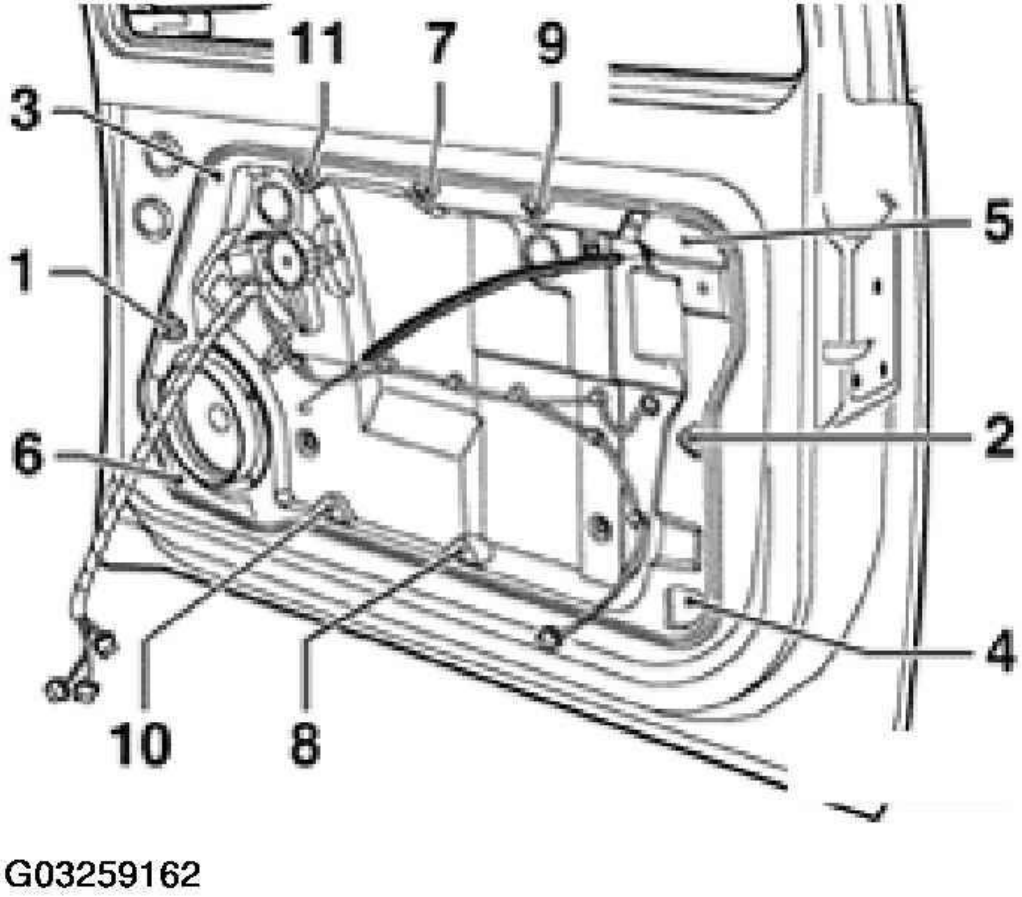

Fig. 37: Removing Crankshaft Oil Seal (Pulley End)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE: A PTFE seal (Teflon) -2- is gradually being introduced instead of the inner coil spring seal -1-. This has a wider sealing lip. PTFE oil seals are installed free of oil and grease. When a PTFE seal is installed, then only such a seal may be installed as a replacement part!

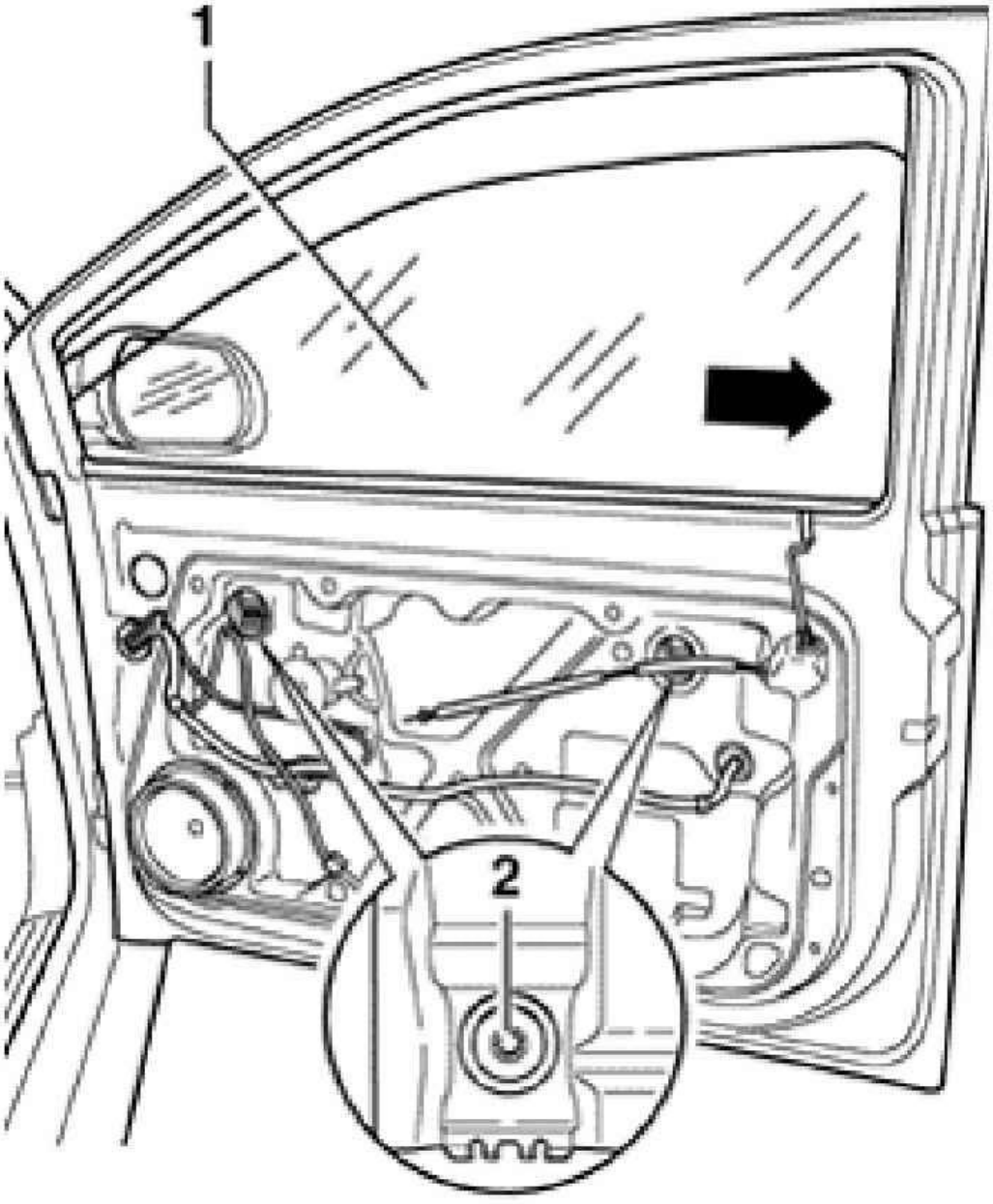

Fig. 38: Identifying Oil Seals (Crankshaft, Pulley End)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Before installing, remove oil remains from crankshaft journal with a clean cloth.

PTFE sealing rings

- Mount guide sleeve T10053/1 onto crankshaft journal.

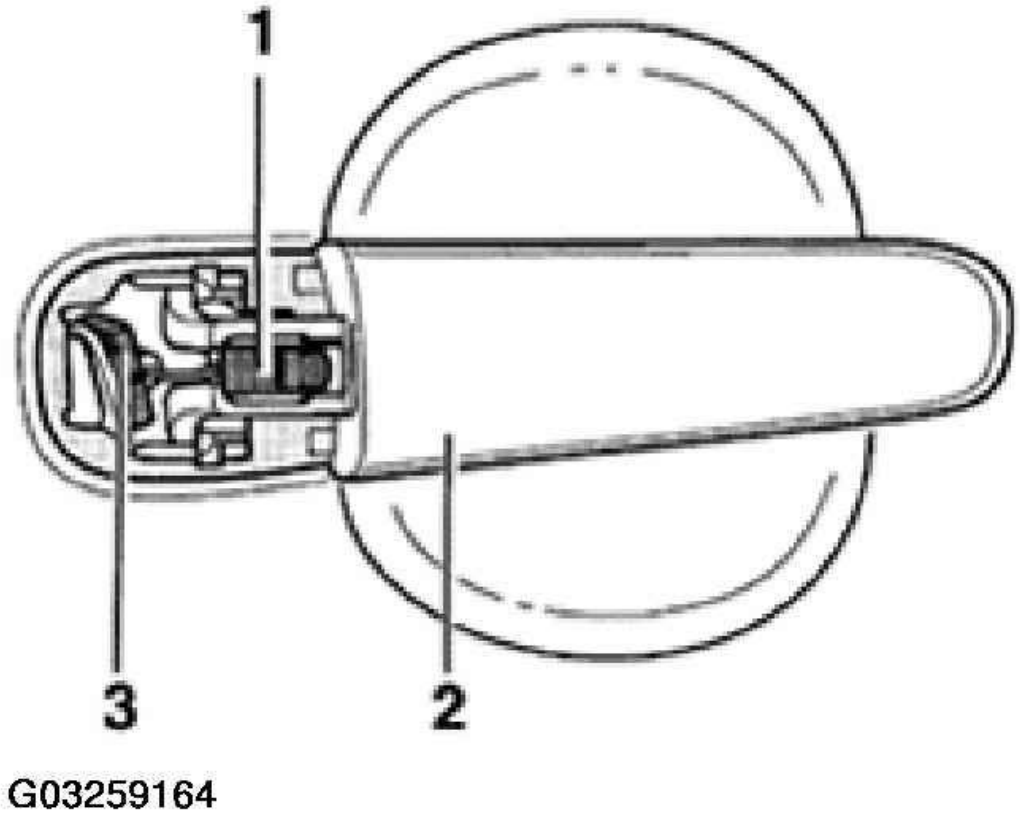

Fig. 39: Mounting Guide Sleeve Onto Crankshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve onto crankshaft journal.
- Press in oil seal onto limit stop using press sleeve T10053 and bolt T10053/2 (M16 x 1.5 x 60).

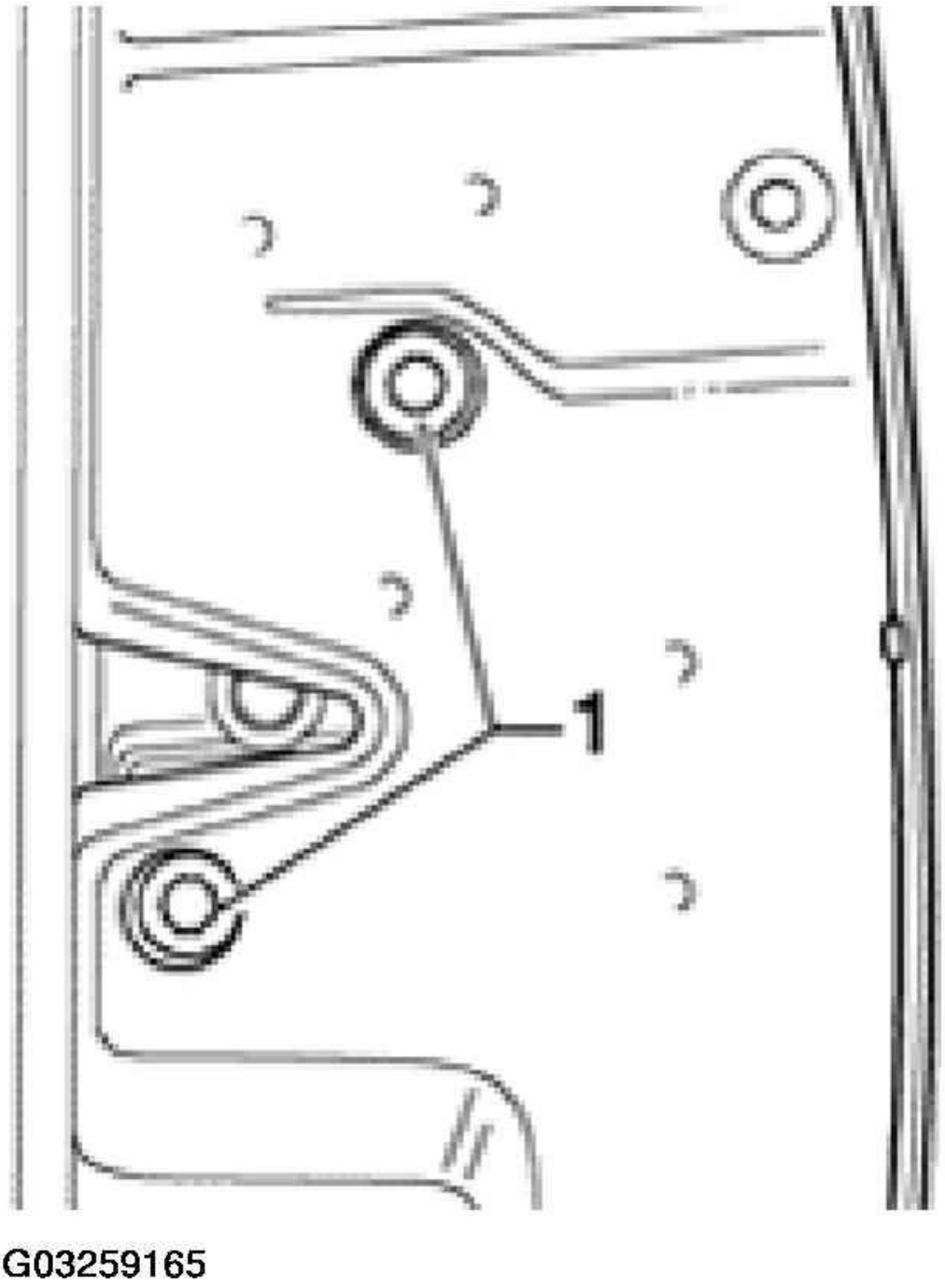

Fig. 40: Pressing In Crankshaft Front Oil Seal (PTFE)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Coil spring seals

- Lightly oil sealing lip of oil seal.
- Mount guide sleeve from 2080 A onto crankshaft journal.

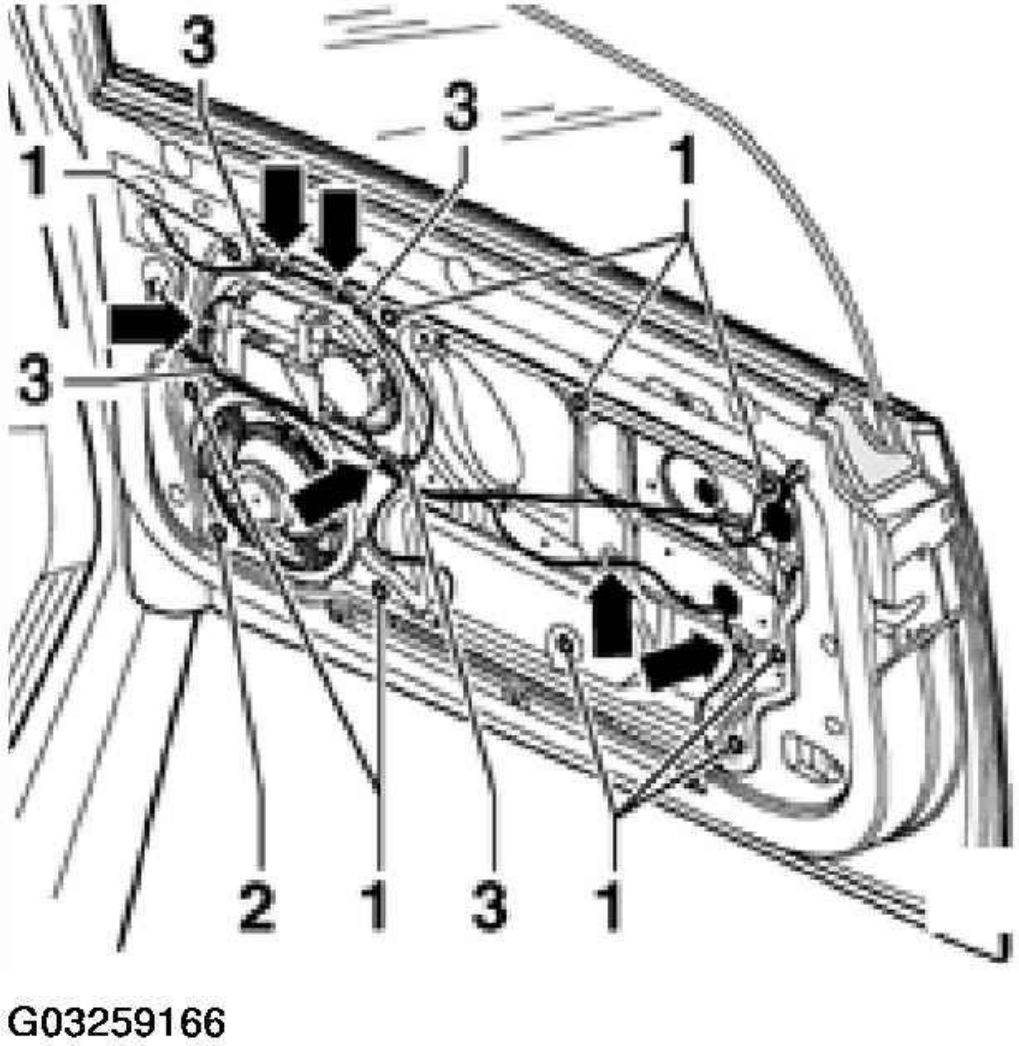

Fig. 41: Mounting Guide Sleeve Onto Crankshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve.
- Press seal against limit stop using press sleeve from 3266. To do this, use old center bolt for crankshaft toothed belt sprocket:

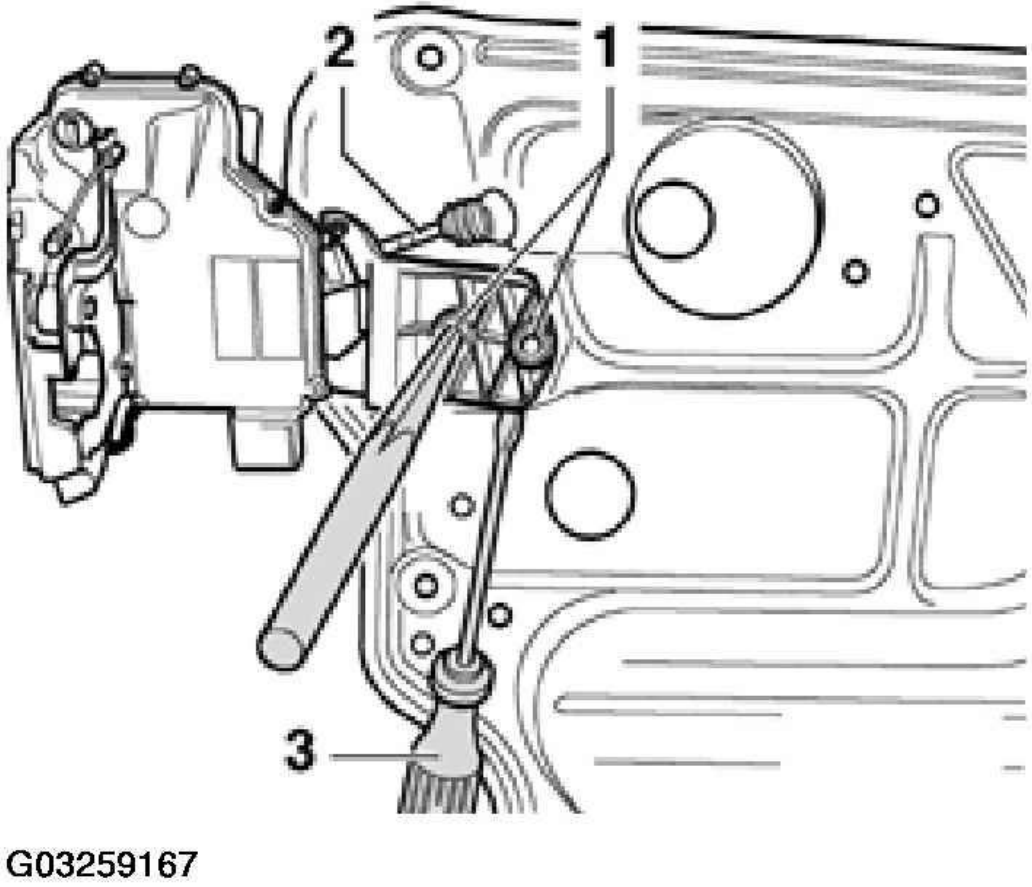

Fig. 42: Pressing Oil Seal (Coil Spring Seal)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press seal against limit stop.

Continuation for all seals

- Install crankshaft toothed belt pulley and counter support with 3415.
- Tighten new center bolt to 90 N.m plus 90° (1/4 turn) further (turning further can be done in several stages).

NOTE: Thread and shoulder must be free of oil and grease.
Installing toothed belt and adjusting timing. See TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING .

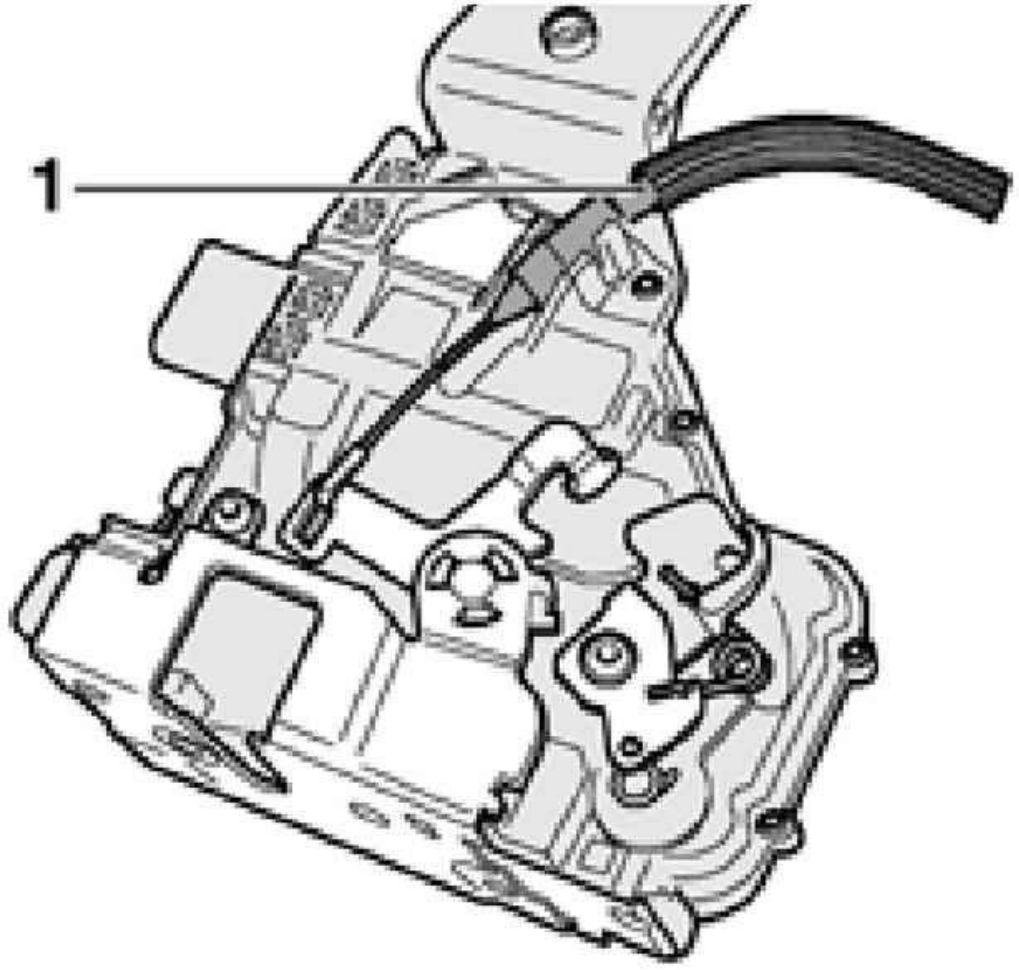

Fig. 43: Installing Crankshaft Toothed Belt Pulley And Counter Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .

Front sealing flange, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

For PTFE seals:

- 3415 Counter support
- T10053 Assembly device
- V.A.G 1331 Torque wrench (5...50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)
- Hand drill with plastic brush attachment
- D 176 404 A2 Silicone sealant
- Flat scraper

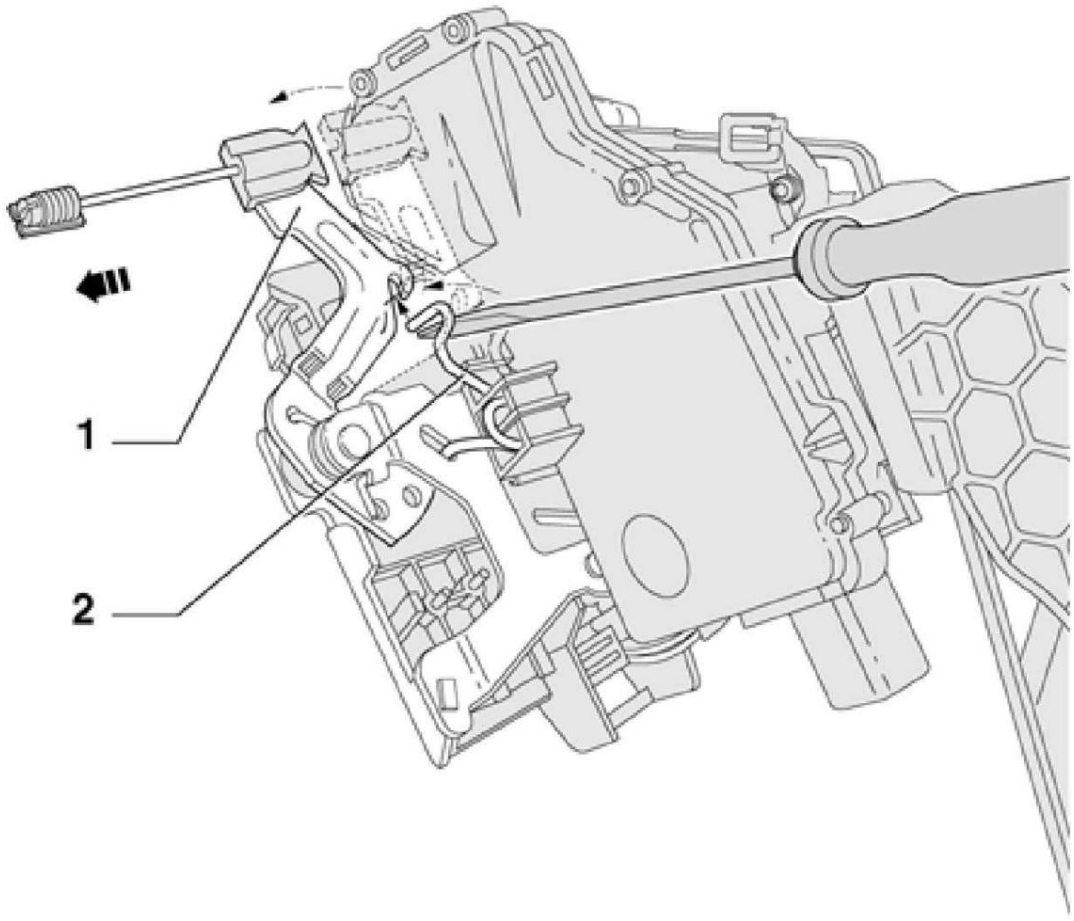

Fig. 44: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

For coil spring seals:

- 2080 A Installation sleeve
- 3415 Counterhold

- V.A.G 1331 Torque wrench (5 ... 50 N.m)
- V.A.G 1332 Torque wrench (40 ... 200 N.m)
- Hand drill with plastic brush attachment
- D 176 404 A2 Silicone sealant
- Flat scraper

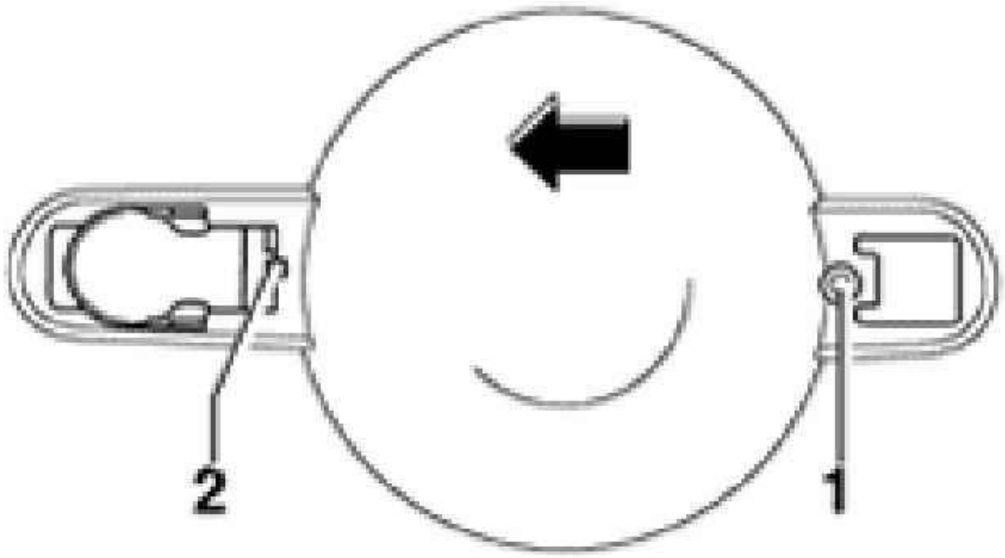

Fig. 45: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Remove tensioning element for ribbed belt.
- Remove toothed (timing) belt. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .
- Remove crankshaft toothed belt pulley. To do this counter support sprocket with 3415.

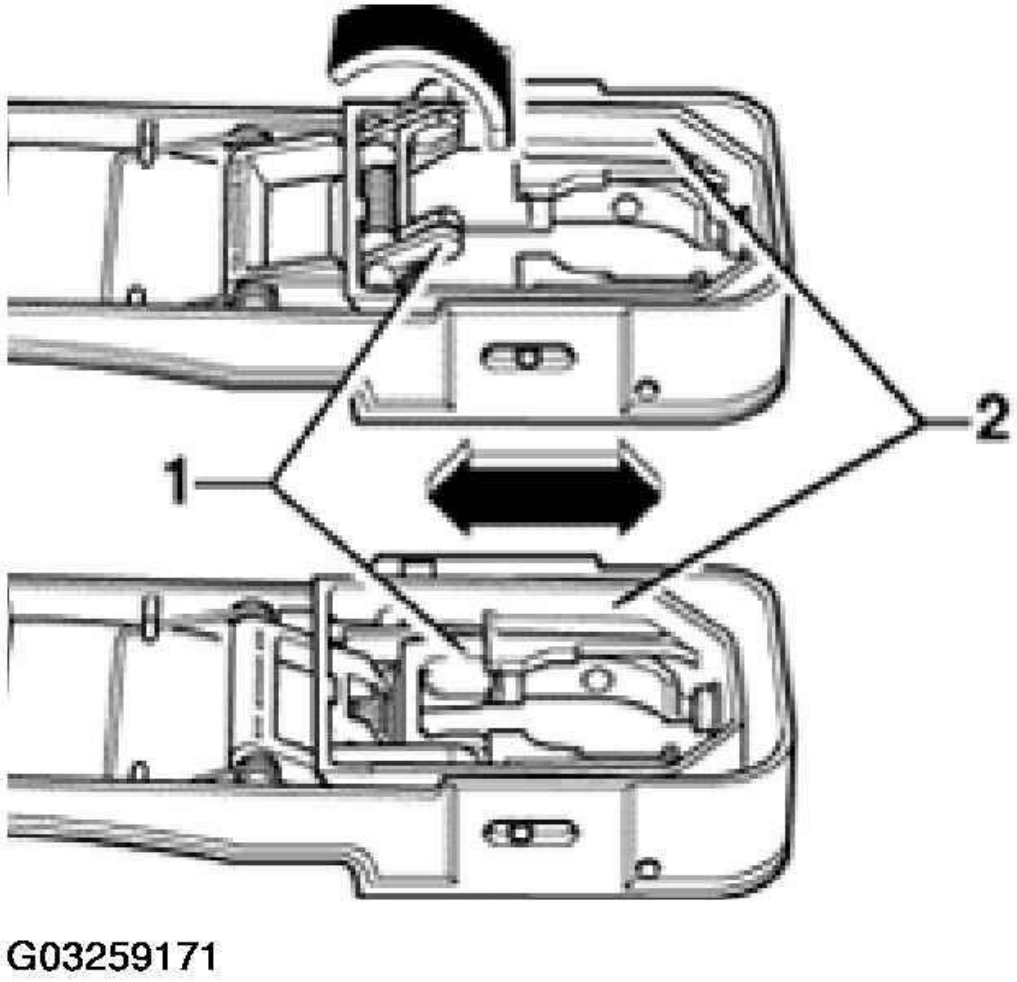

Fig. 46: Removing Crankshaft Toothed Belt Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Drain engine oil.
- Remove oil sump. See **OIL SUMP, REMOVING AND INSTALLING** .
- Unbolt front sealing flange.
- Take off sealing flange, release using light blows with a rubber headed hammer if necessary.
- Remove sealant residue from cylinder block with a flat scraper.

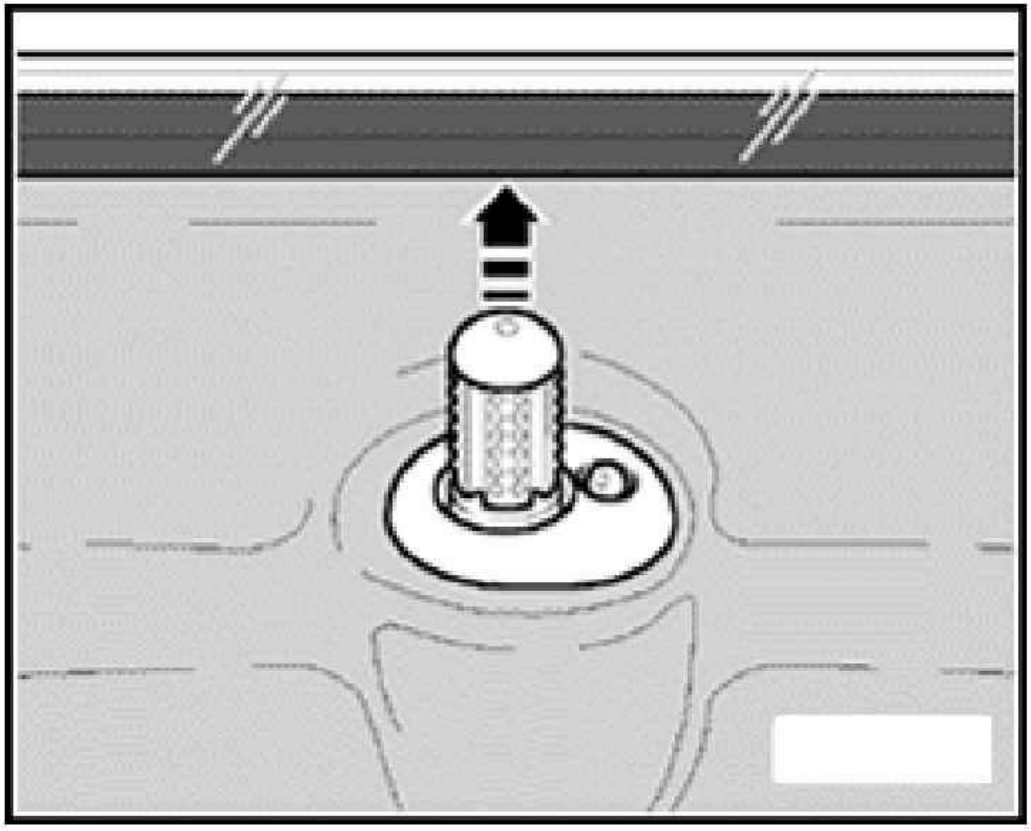

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Fig. 47: Removing Sealant Remains On Front Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Cover oil seal with a clean cloth.
- Remove sealant remains on sealing flange with a rotating plastic brush (wear protective goggles).
- Clean sealing surfaces. Surfaces must be free of oil and grease.

Installing

- Cut off tube nozzle at front marking (nozzle approx. 3 mm diameter).
- Apply silicone sealing compound, as shown, to clean sealing surface of sealing flange.
  - Thickness of sealant bead (arrows): 2 ... 3 mm

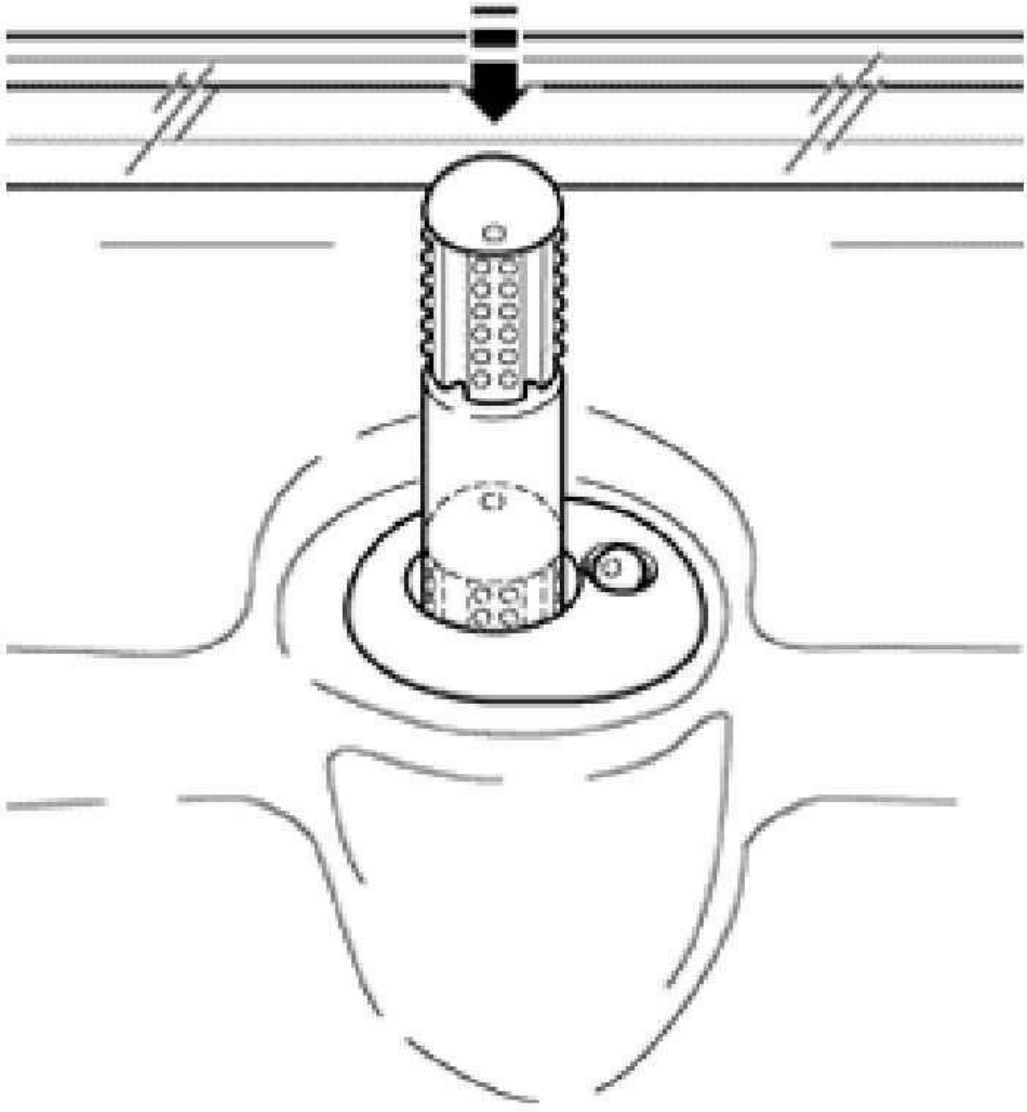

Fig. 48: Applying Silicone Sealing Compound To Sealing Surface Of Front Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **Before applying sealing bead, cover the oil seal with a clean cloth.**
- **The sealing compound bead must not be thicker, otherwise excessive sealing compound will enter the sump and may block**

the oil suction pipe strainer.

- **Note the use-by date of the sealant.**
- **The sealing flange must be installed within 5 minutes of applying the silicone sealing compound.**

PTFE sealing rings

NOTE: Use guide sleeve T10053/1 to fit sealing flange with the oil seal already installed.

Coil spring seals

NOTE: Use guide sleeve 2080 A to fit sealing flange with the oil seal already installed.

Continuation for all seals

NOTE: The sealant must be allowed to cure for approx. 30 minutes after installing the sump. After this time the engine may be filled with engine oil.

- Install sealing flange immediately and lightly tighten all bolts.
- Tighten sealing flange securing bolts using an alternating sequence and torque to 15 N.m.
- Remove excess sealing compound.
- Install sump. See **OIL SUMP, REMOVING AND INSTALLING** .
- Install crankshaft toothed belt pulley and counter support with 3415. Torque bolts to 90 N.m + 1/4 turn (90°) further.

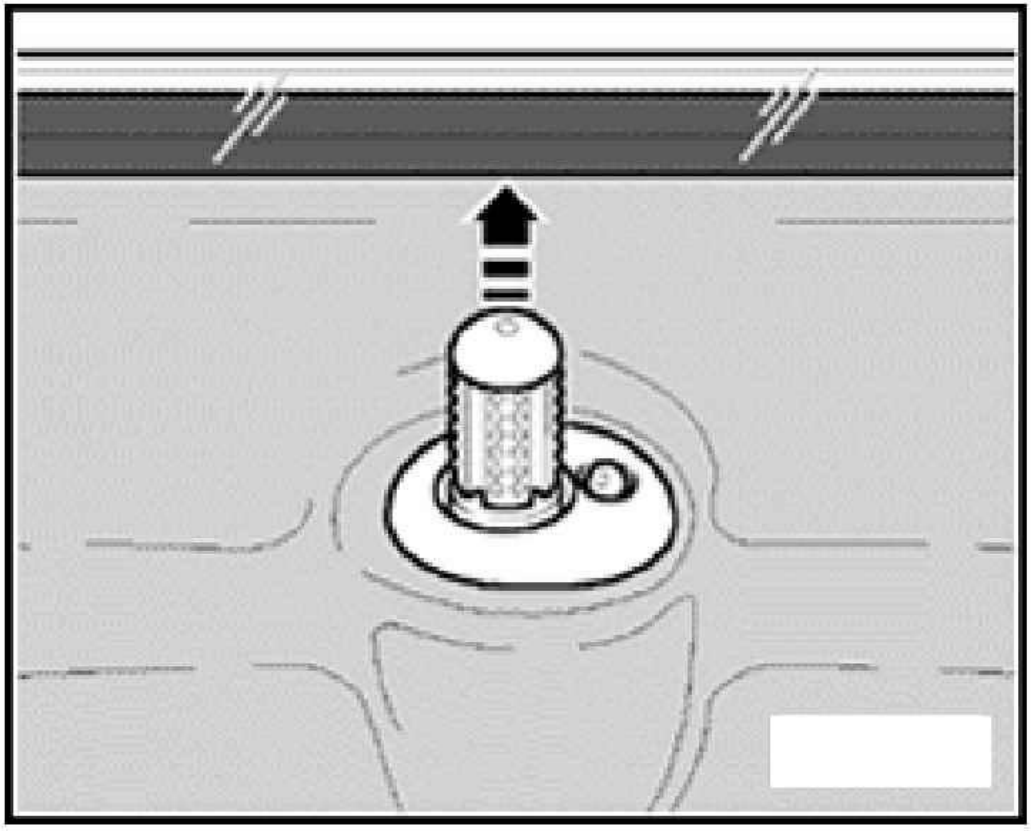

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Fig. 49: Installing Crankshaft Toothed Belt Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Thread and shoulder must be free of oil and grease.

- Install toothed belt and adjust timing. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .
- Install tensioning element for ribbed belt.
- Install ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .

Drive plate, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- VW 558 Counter support tool

- Hex bolt M8 x 45 and two M10 hex nuts
- Depth gauge

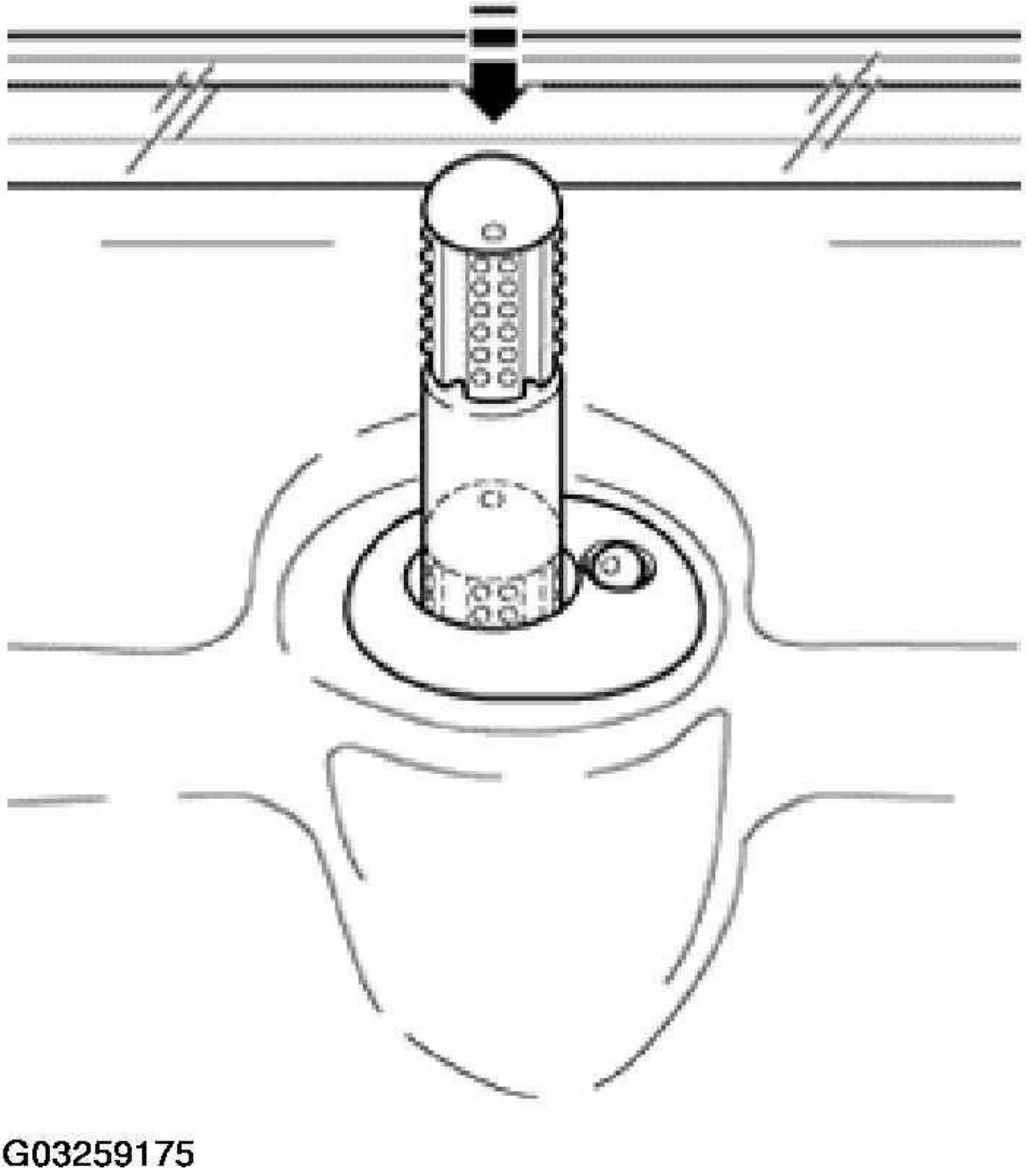
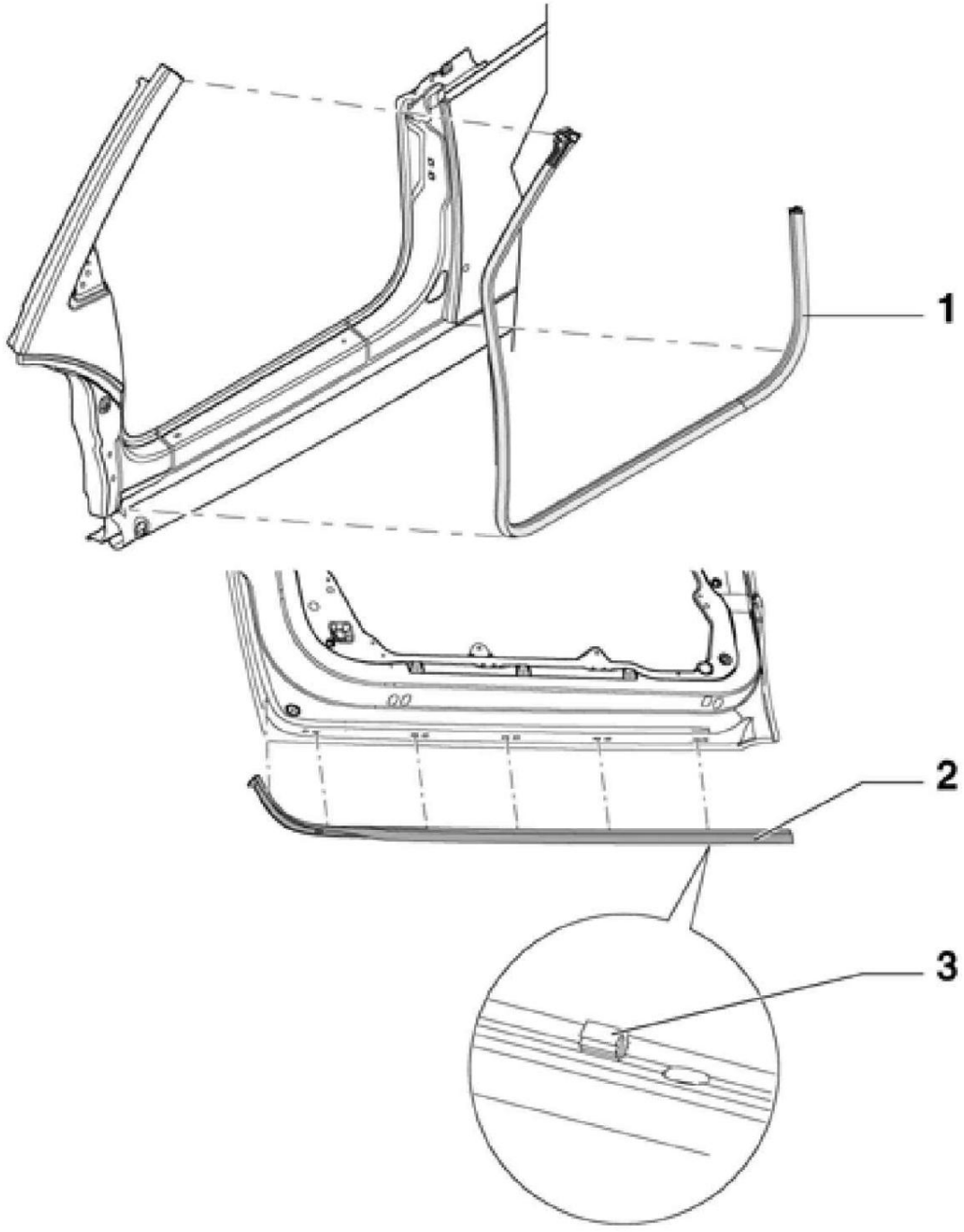


Fig. 50: Identifying Special Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Loosening and tightening drive plate

- Secure counter support tool VW 558 to the drive plate with a M8 x 45 hex bolt. Place two M10 hex nuts between counter support tool and drive plate.



1 - Door inner seal

2 - Dust seal

3 - Clip

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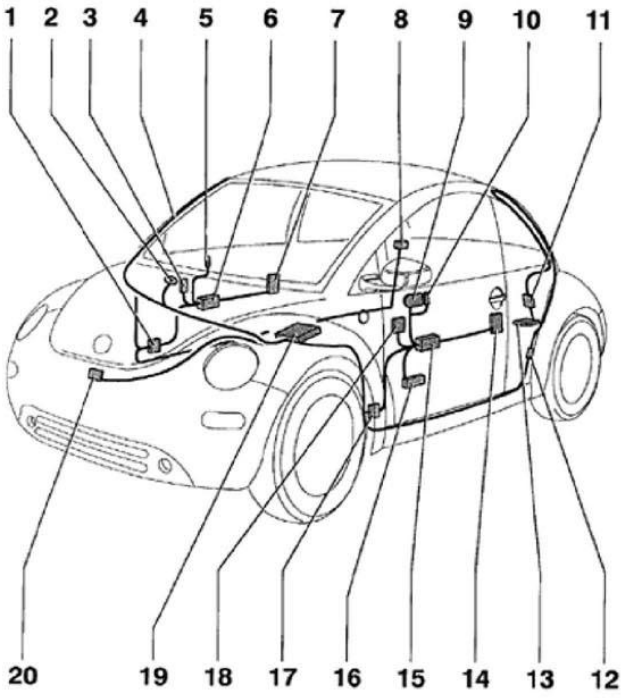
Fig. 51: Securing Counter Support Tool To Drive Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Position of counter support tool:

A. To loosen
B. To tighten

Installing drive plate

- Locate drive plate and packing plate with recesses -1-.
- Install new bolts -3- and tighten to 30 N.m.



1 - Coupling station
2 - Anti-theft alarm horn
3 - Front right power window switch
4 - Aerial for remote control
5 - Interior locking switch, front passenger's side
6 - Front right door control unit
7 - Front right door lock
8 - Motor for fuel tank lid unlock V155
9 - Exterior mirror adjustment switch and change-over switch
10 - Interior locking switch, driver's side
11 - Tailgate/trunk lid remote release motor
12 - Coupling station
13 - Hood lock
14 - Front left door lock
15 - Front left door control unit
16 - Controls
17 - Coupling station
18 - Power window switch
19 - Central control unit
20 - Hood lock

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Fig. 52: Installing Drive Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Measure dimension -a- at three different outer holes of drive plate (120° offset) and calculate average.

Specification: 19.5...21.1 mm

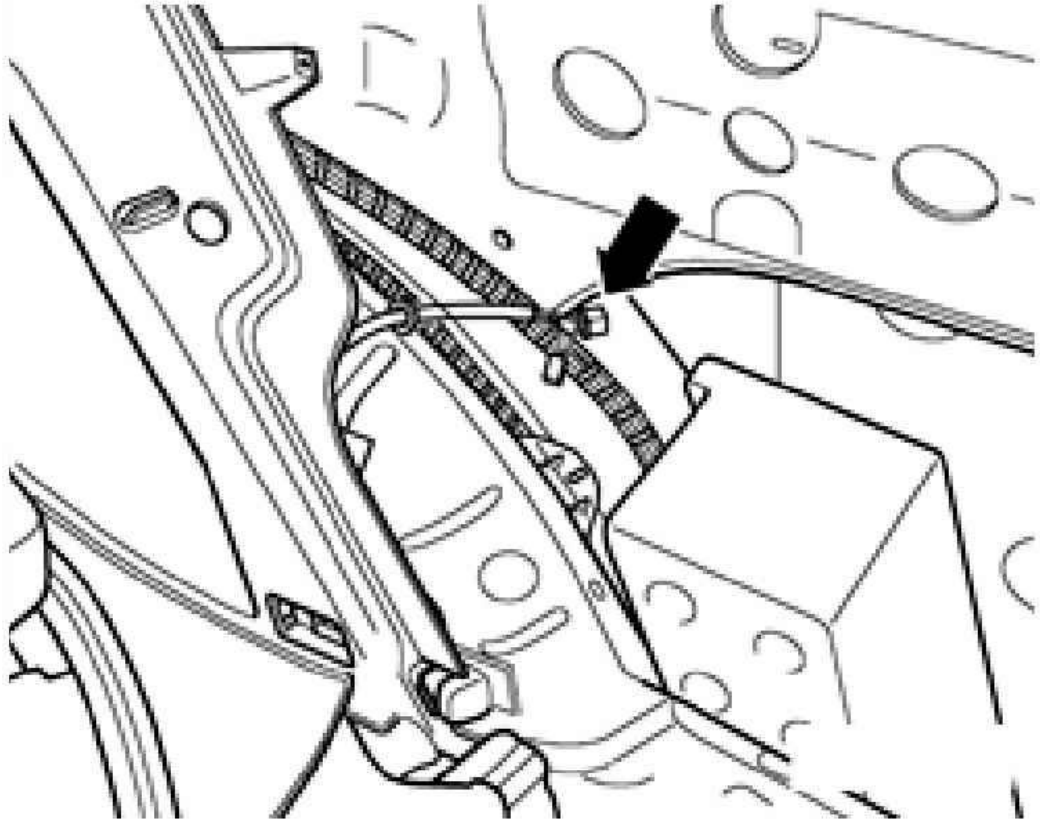

Fig. 53: Measuring Clearance Between Drive Plate And Engine Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Measure through hole in drive plate to milled surface of cylinder block. To do this unhook intermediate plate (See Fig. 32).

If the specification is not attained:

- Remove drive plate again and install shim -2-. Again tighten bolts -3- to 30 N.m.

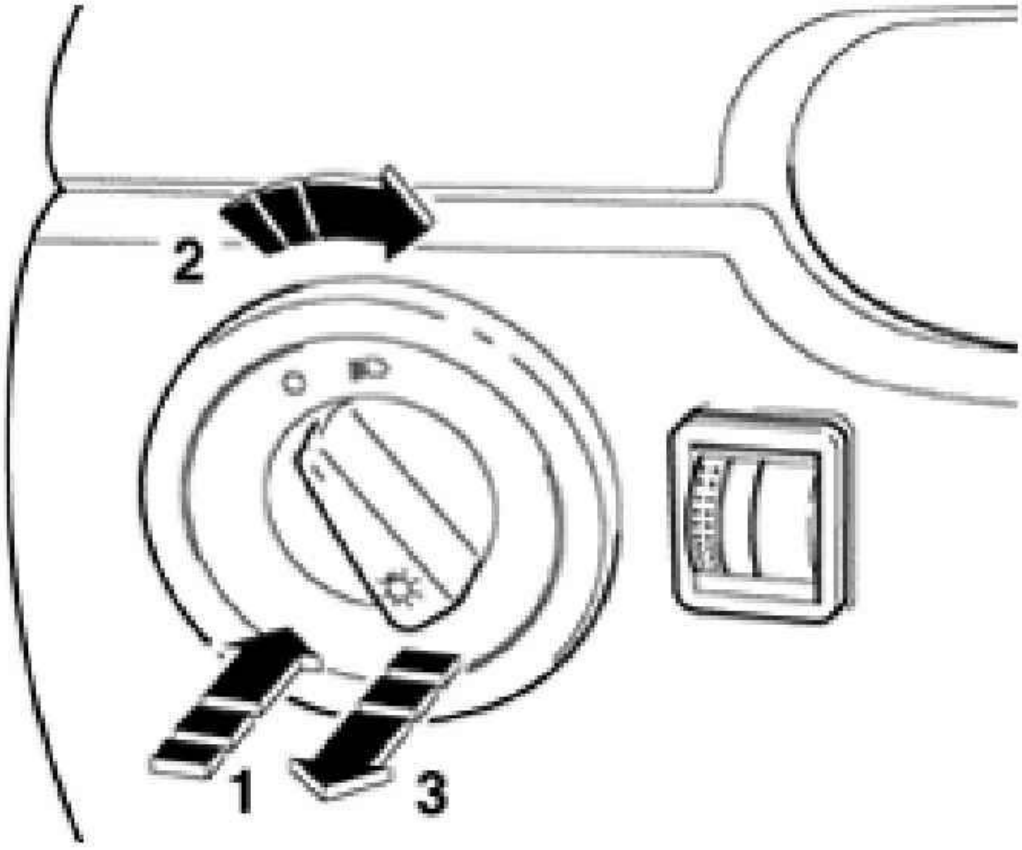

Fig. 54: Installing Drive Plate With Shim
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten bolts to 60 N.m and 90° (1/4turn) further (turning further can be done in several stages).

CRANKSHAFT, REMOVING AND INSTALLING

NOTE:

- **Before removing the crankshaft, prepare a suitable place to set it to ensure that the sensor wheel (item -8-) is free and does not get damaged.**
- **When stripping and assembling the engine it should be secured to the engine frame with engine and transmission bracket VW 540 and supplementary set VW 540/1B.**

Engine codes AEG, AVH, AZG, BEV

NOTE: The following list refers to items in Fig. 55 .

1. **Oil pump**
   - With pressure relief valve of 12 bar
   - Before installing, check that both dowel sleeves for centralizing oil pump/cylinder block are installed
   - Removing and installing. See **LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING**
2. **15 N.m**
3. **Chain sprocket**
   - For oil pump drive
4. **Bearing shells 1,2, 3, 4 and 5**
   - Classification for ordering spare parts. See **Fig. 57**
   - For bearing cap without oil groove
   - For cylinder block with oil groove
   - Do not interchange used bearing shells (mark)
5. **65 N.m + 90° (1/4 turn) further**
   - Replace
   - Threaded along complete length (screw)
   - Tighten to 65 N.m when measuring crankshaft radial clearance
6. **Bearing cap**
   - Bearing cap 1: Poly V-belt pulley end
   - Bearing cap 3 with recesses for thrust washers
   - Bearing shell retaining lugs (cylinder block/bearing cap) must be on same side
7. **Bearing shell 3**
   - See item - 4 -
   - Do not interchange used bearing shells (mark)
8. **Sensor wheel**
   - Replace
   - For Engine speed (RPM) sensor -G28-
   - Can only be installed in one position. Holes are offset
9. **10 N.m + 1/4 turn (90°) further**
   - Replace
10. **Thrust washer**
    - For bearing 3 bearing cap
    - Production version (1-part), upper thrust washers discontinued, item -12-
    - Observe method of securing
    - Lettering faces mounting bracket

11. **Crankshaft**
    - Axial clearance, new: 0.07 ... 0.23 mm; Wear limit: 0.30 mm
    - Check radial clearance with Plastigage, new: 0.01 ... 0.04 mm; Wear limit: 0.15 mm
    - Do not rotate crankshaft when checking radial clearance
    - Crankshaft dimensions. See **CRANKSHAFT DIMENSIONS**
12. **Thrust washer**
    - For cylinder block, bearing 3
    - Spare part version (2-part), lower thrust washers are only semicircular
    - Lettering faces mounting bracket

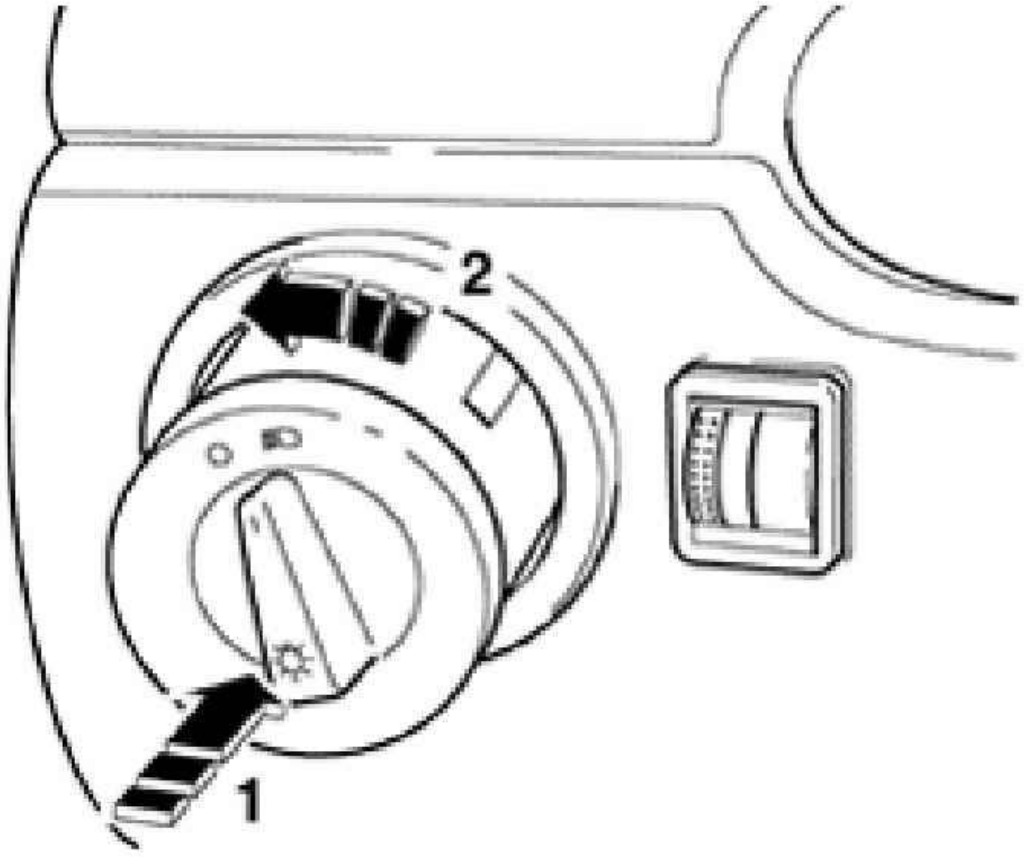

Fig. 55: Exploded View Of Crankshaft Assembly (Engine Codes AEG, AVH, AZG, BEV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The balancer shaft gear assembly must be adjusted. See OIL PUMP WITH BALANCER SHAFT GEAR ASSEMBLY, REMOVING AND INSTALLING .

NOTE: The following list refers to items in Fig. 56 .

1. **Chain sprocket**
2. **Bearing shells 1,2, 3, 4 and 5**
   - Classification for ordering spare parts. See **Fig. 57**
   - For bearing cap without oil groove
   - For cylinder block with oil groove
   - Do not interchange used bearing shells (mark)
3. **65 N.m + 90° (1/4 turn) further**
   - Replace
   - Threaded along complete length (screw)
   - Tighten to 65 N.m when measuring crankshaft radial clearance
4. **Bearing cap**
   - Bearing cap 1: Ribbed belt pulley end
   - Bearing cap 3 with recesses for thrust washers
   - Bearing shell retaining lugs (cylinder block/bearing cap) must be on same side
5. **Bearing shell 3**
   - See Step 2
   - Do not interchange used bearing shells (mark)
6. **Sensor wheel**
   - Replace
   - For Engine speed (RPM) sensor -G28-
   - Can only be installed in one position. Holes are offset
7. **10 N.m + 1/4 turn (90°) further**
   - Replace
8. **Thrust washer**
   - For bearing 3 bearing cap
   - Observe adjustment
   - Lettering faces mounting bracket
9. **Crankshaft**
   - Axial clearance, new: 0.07...0.23 mm; Wear limit: 0.30 mm
   - Check radial clearance with Plastigage, new: 0.01...0.04 mm, Wear limit: 0.07 mm
   - Do not rotate crankshaft when checking radial clearance

- Crankshaft dimensions. See **CRANKSHAFT DIMENSIONS**

10. **Thrust washer**
    - For cylinder block, bearing 3
    - Lettering faces mounting bracket

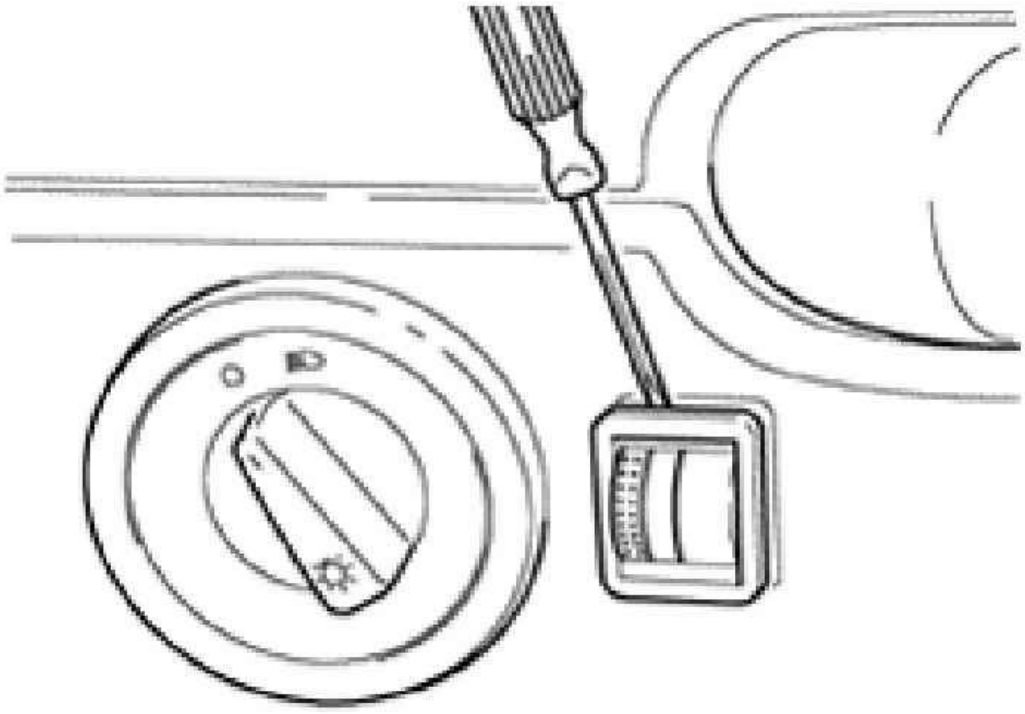

Fig. 56: Exploded View Of Crankshaft Assembly (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Upper crankshaft bearing identification (gradual introduction)

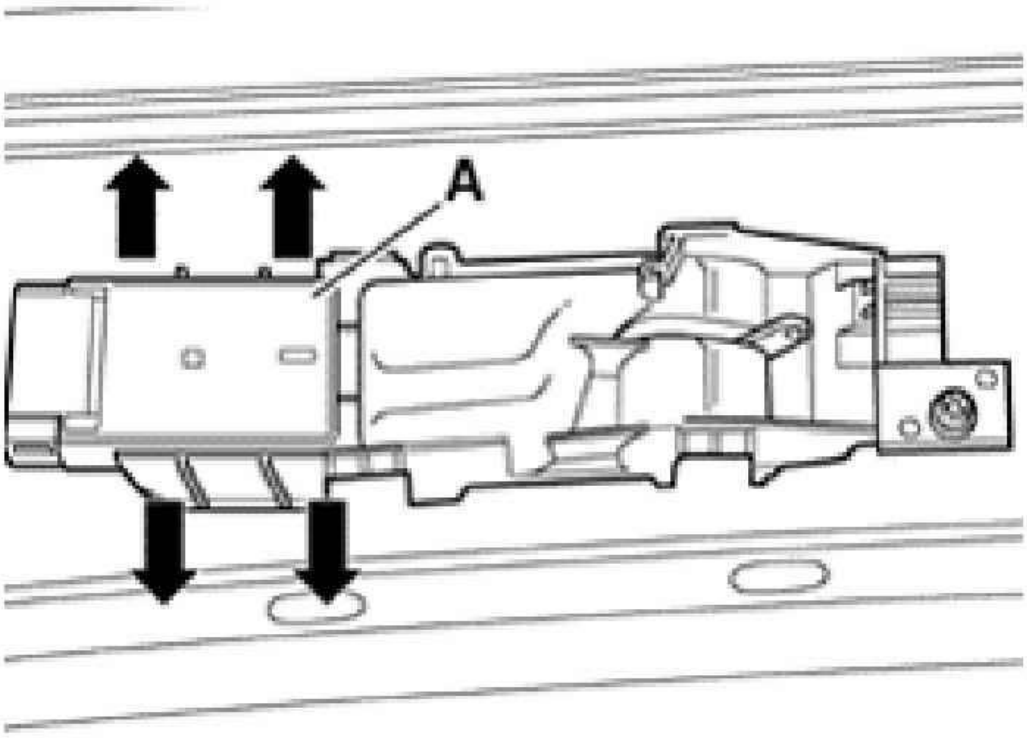

Fig. 57: Locating Upper Crankshaft Bearing Identification Marks
Courtesy of VOLKSWAGEN OF AMERICA, INC.

In the factory the upper bearing caps are allocated with the correct thickness for the cylinder block. Colored marks are used to identify the thickness of the bearing shells. See **CRANKSHAFT BEARING COLOR MARKINGS** .

Which thickness of shell should be installed to which location is marked by a letter on the lower sealing surface of the cylinder block -x-.

Arrow indicates direction of travel (forward).

Crankshaft bearing color markings

CRANKSHAFT BEARING COLOR MARKINGS SPECIFICATIONS

Letter on cylinder block	Color of bearing
S =	Black
R =	Red

G =	Yellow

NOTE:

- **If the colored marks have not been stamped or are no longer legible, use the average bearing shell (red).**
- **The lower crankshaft bearing shells are always supplied as a spare part with the color marking "yellow".**

Crankshaft dimensions

Dimensions in mm.

CRANKSHAFT DIMENSIONS SPECIFICATIONS

Grinding dimension(1)	Crankshaft bearing journal diameter	Connecting rod journal diameter
Basic dimension	-0.017 54.00 -0.037	-0.022 47.80 -0.042
1st undersize	-0.017 53.75 -0.037	-0.022 47.55 -0.042
2nd undersize	-0.017 53.50 -0.037	-0.022 47.30 -0.042
3rd undersize	-0.017 53.25 -0.037	-0.022 47.05 -0.042
(1) All dimensions are in mm.		

PISTON AND CONNECTING ROD, DISASSEMBLING AND ASSEMBLING

Gradual introduction of "industrially fractured" connecting rods.

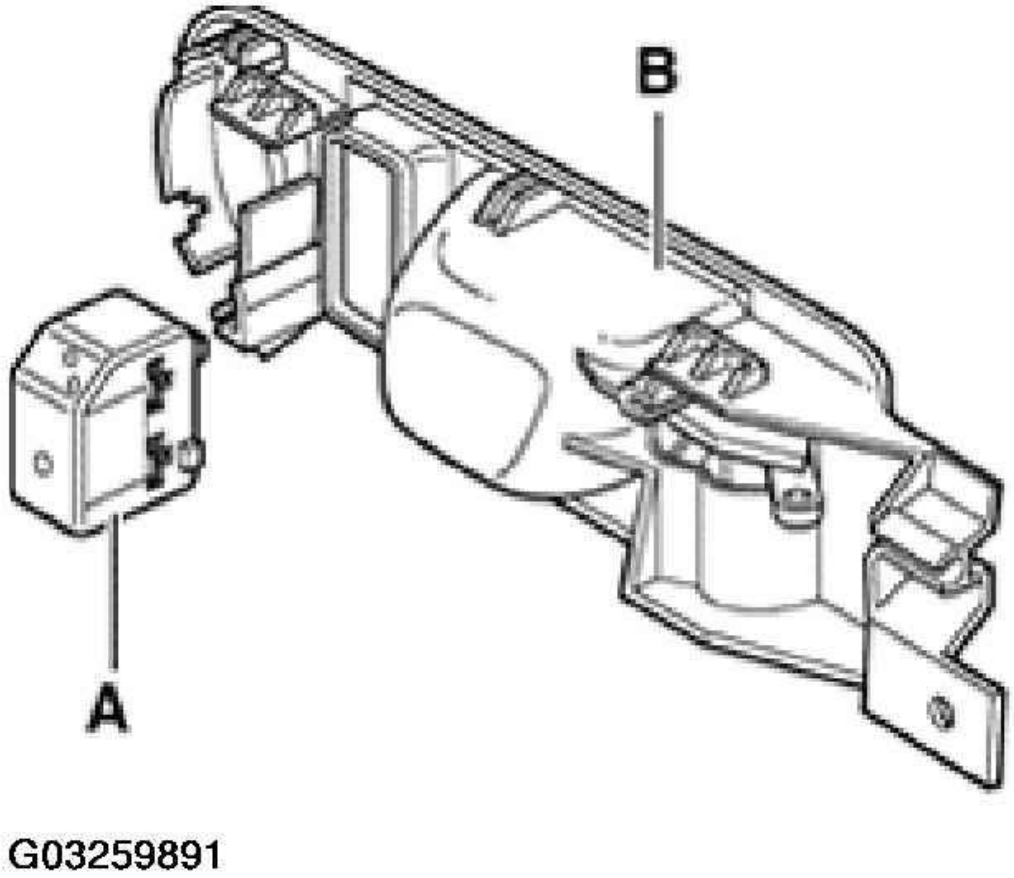

Fig. 58: Identifying "Industrially Fractured" Connecting Rods
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Distinguishing features:

A. Older type connecting rods (smooth joint along contact surface)
B. Industrially fractured connecting rods (rough joint along contact surface)

- Disassembling and assembling piston and older type connecting rod. See **OLDER TYPE CONNECTING RODS**
- Disassembling and assembling piston and industrially fractured connecting rod. See **INDUSTRIALLY FRACTURED CONNECTING RODS**

Older type connecting rods

NOTE: The following list refers to items in Fig. 59 .

1. **Piston rings**
   - Offset gaps by 120°
   - Use piston ring pliers to remove and install
   - "TOP" faces piston crown
   - Checking ring gap. See **Fig. 61**
   - 2-part oil scraper ring
2. **Piston**
   - Checking. See **Fig. 63**
   - Mark installation position and cylinder number
   - Arrow on piston crown points to belt pulley end
   - Checking ring to groove clearance. See **Fig. 62**
   - Install using piston ring clamp
3. **Connecting rod**
   - Only replace as a set
   - Mark allocation to cylinder -B-
   - Installation position: Marking -A- faces belt pulley end
4. **Connecting rod bearing cap**
   - Mark allocation to cylinder -B-
   - Installation position: Marking -A- faces belt pulley end
5. **30 N.m + 1/4 turn (90°) further**
   - Replace
   - Oil thread and contact surface
   - To measure radial clearance tighten to 30 N.m, but do not turn further
6. **Bearing shell**
   - Observe installing position
   - Do not interchange used bearing shells
   - Ensure retaining lugs fit tightly in recesses
   - Upper bearing shell with oil drilling for piston pin lubrication
   - Axial clearance, new: 0.05 ... 0.31 mm; Wear limit: 0.37 mm
   - Check radial clearance with Plastigage, new: 0.01 ... 0.06 mm; Wear limit: 0.12 mm
   - Do not rotate crankshaft when checking radial clearance
7. **Cylinder block**
   - Checking cylinder bore. See **Fig. 65**
   - Piston and cylinder dimensions. See **PISTON AND CYLINDER DIMENSIONS**
8. **Connecting rod bolt**

9. **Circlip**
10. **Piston pin**
    - If difficult to remove, heat piston to 60° C
    - Remove and install with VW 222a

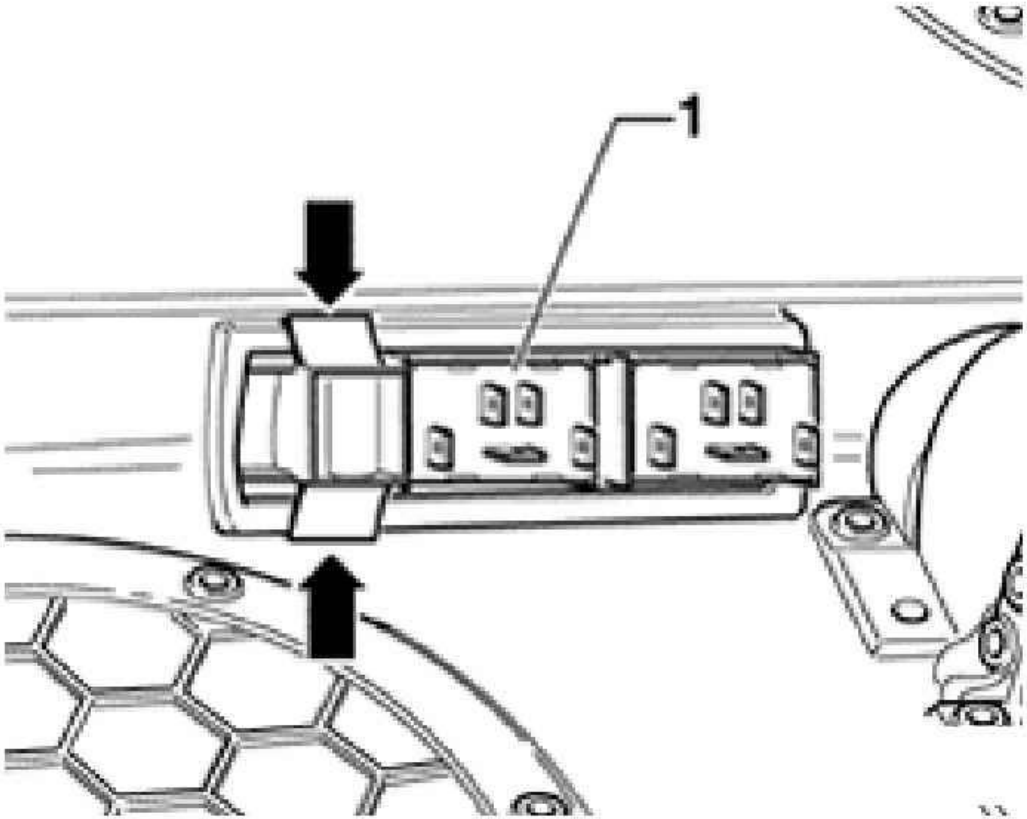

Fig. 59: Exploded View Of Piston And Connecting Rod Assembly (Older Type Connecting Rods)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Industrially fractured connecting rods

NOTE: The following list refers to items in Fig. 60 .

1. **Piston rings**
    - Offset gaps by 120°

- Use piston ring pliers to remove and install
- "TOP" faces piston crown
- Checking ring gap. See **Fig. 61**
- Checking ring to groove clearance. See **Fig. 62**
- Oil scraper ring 2- or 3-part

2. **Piston**
   - Checking. See **Fig. 63**
   - Mark installation position and cylinder number
   - Arrow on piston crown points to pulley end
   - Install using piston ring clamp
3. **Floating piston pin**
   - If difficult to remove, heat piston to 60 °C
   - Remove and install with VW 222A
4. **Snap ring**
5. **Connecting rod**
   - With cracked bearing cap
   - Only replace as a set
   - Mark relationship to cylinder -B-
   - Installation position: Marking -A- faces belt pulley end
6. **Bearing shell**
   - Observe installation position. See **Fig. 64** .
   - Insert bearing shells centrally
   - Do not interchange used bearing shells
   - Check if seated securely
   - Axial clearance, new: 0.10...0.35 mm; Wear limit: 0.4 mm
   - Check radial clearance with Plastigage, new: 0.01...0.05 mm; Wear limit: 0.09 mm
   - Do not rotate crankshaft when checking radial clearance
7. **Cylinder block**
   - Checking cylinder bore. See **Fig. 65**
   - Piston and cylinder dimensions. See **PISTON AND CYLINDER DIMENSIONS**
8. **Connecting rod bearing cap**
   - Observe installing position
   - Caps only fit in one position and only on appropriate connecting rod due to breaking procedure (industrially fracturing) separating cap from connecting rod
9. **30 N.m + 1/4 turn (90°) further**
   - Torx E 10
   - Replace

- Oil thread and contact surface
- To measure radial clearance tighten to 30 N.m, but do not turn further

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Fig. 60: Exploded View Of Piston And Connecting Rod Assembly (Industrially Fractured Connecting Rods)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Piston Ring Gap

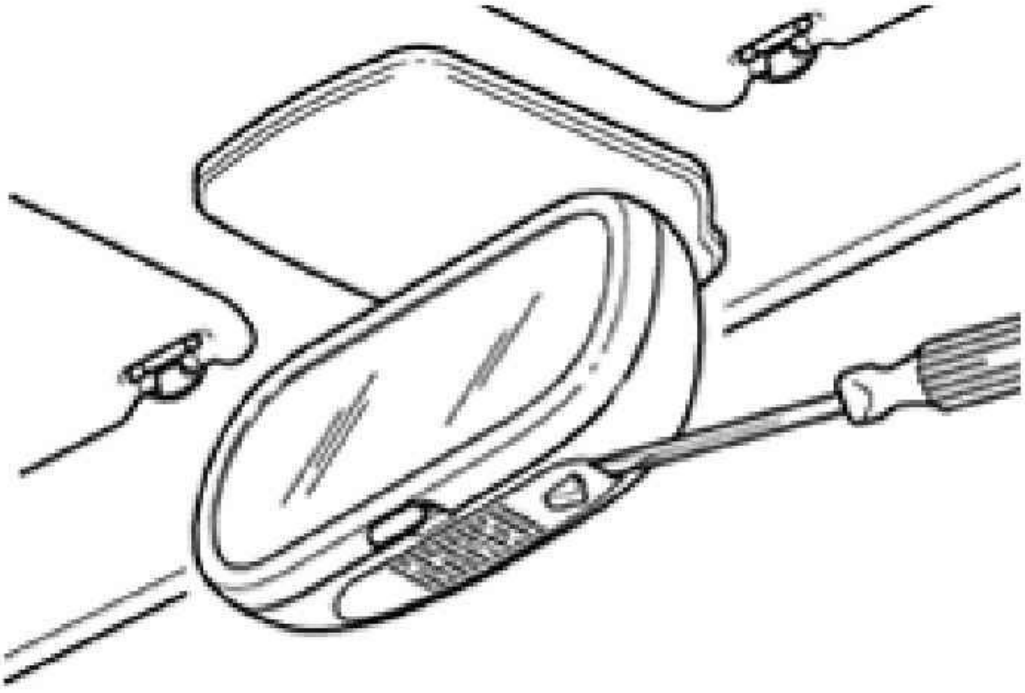


Fig. 61: Checking Piston Ring End Gap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools, testers, measuring instruments and auxiliary items required

- Feeler gauge

Work sequence

- Push ring squarely from above down to approx. 15 mm from bottom end of cylinder.

PISTON RING END GAP SPECIFICATIONS

Piston Ring	New	Wear limit
Compression mm rings	0.20...0.40	0.8
Oil scraper ring mm	0.25...0.50	0.8

Checking Ring To Groove Clearance

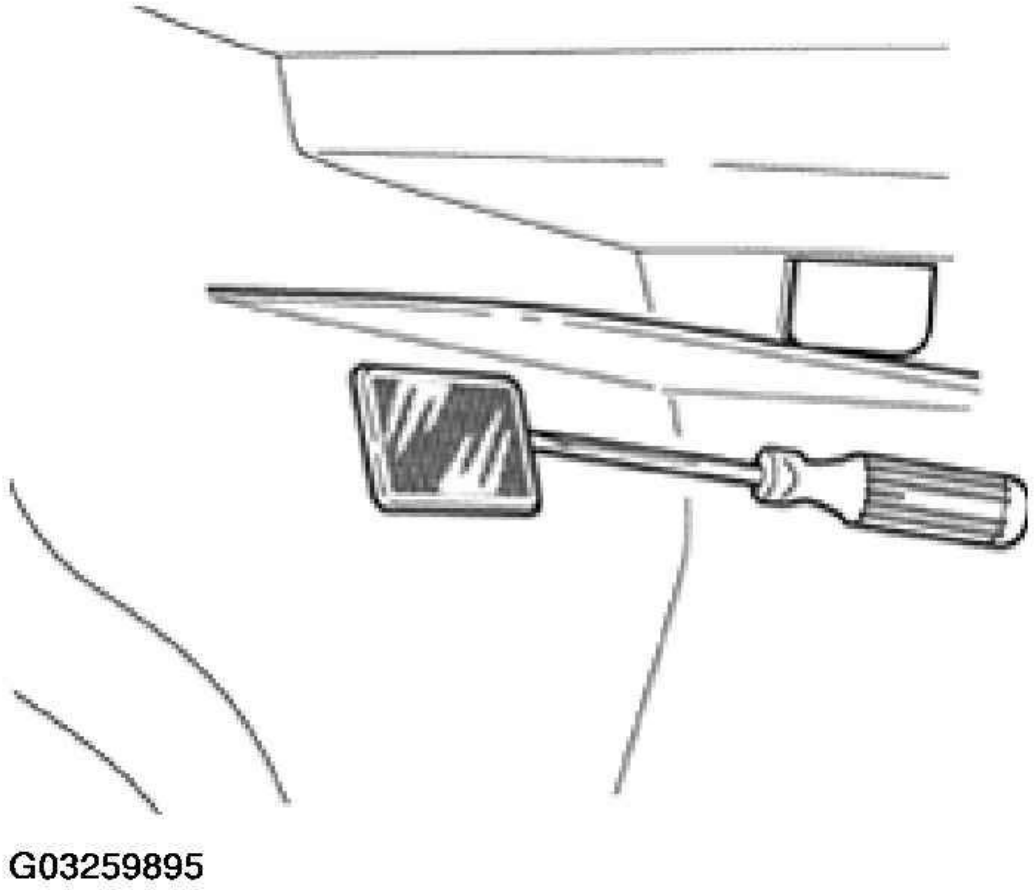


Fig. 62: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools, testers, measuring instruments and auxiliary items required

- Feeler gauge

Work sequence

Clean groove before checking.

PISTON RING TO GROOVE CLEARANCE SPECIFICATIONS

Piston Ring	New	Wear limit
Compression rings mm	0.06...0.09	0.20
Oil scraper ring	0.03...0.06	0.15

mm		

Measuring Piston Lower Edge Of Skirt

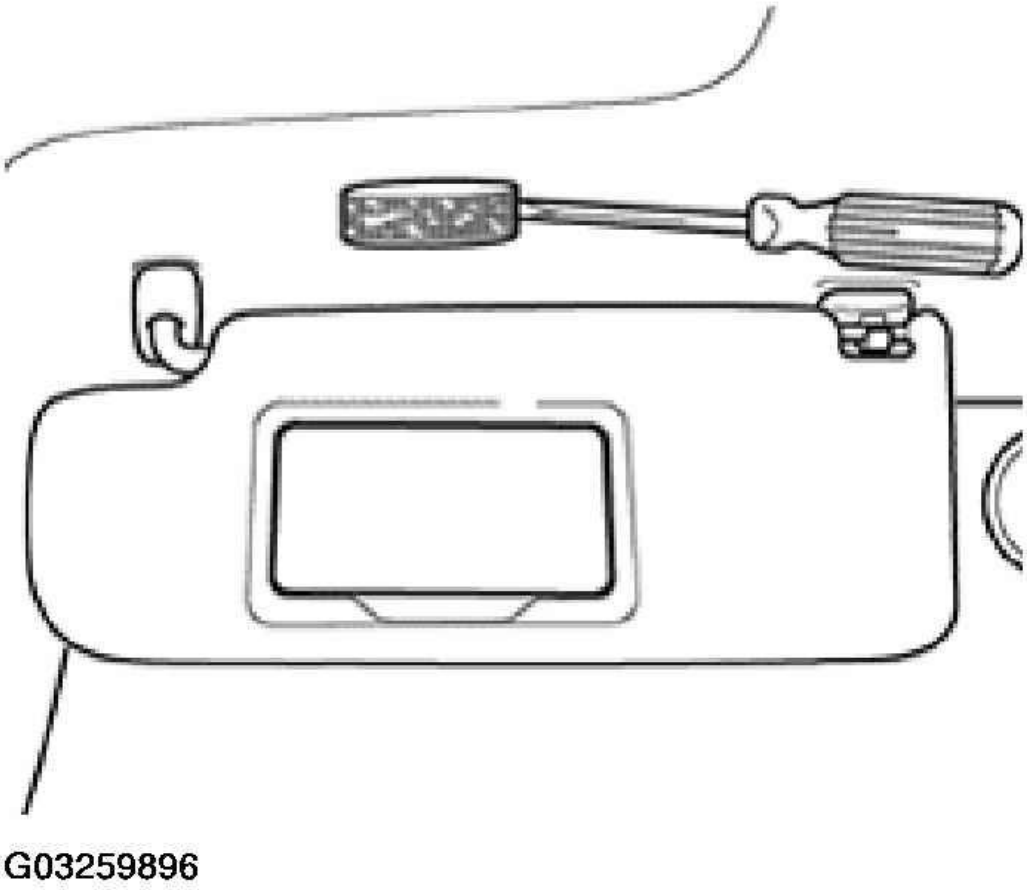


Fig. 63: Measuring Piston Lower Edge Of Skirt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools, testers, measuring instruments and auxiliary items required

- External micrometer 75...100 mm

Work sequence

- Measure pistons approx. 10 mm from the lower edge of skirt, 90° offset to axis of floating piston pin.

  Deviation from nominal dimension: max. 0.04 mm

Installation Position Of Bearing Shells

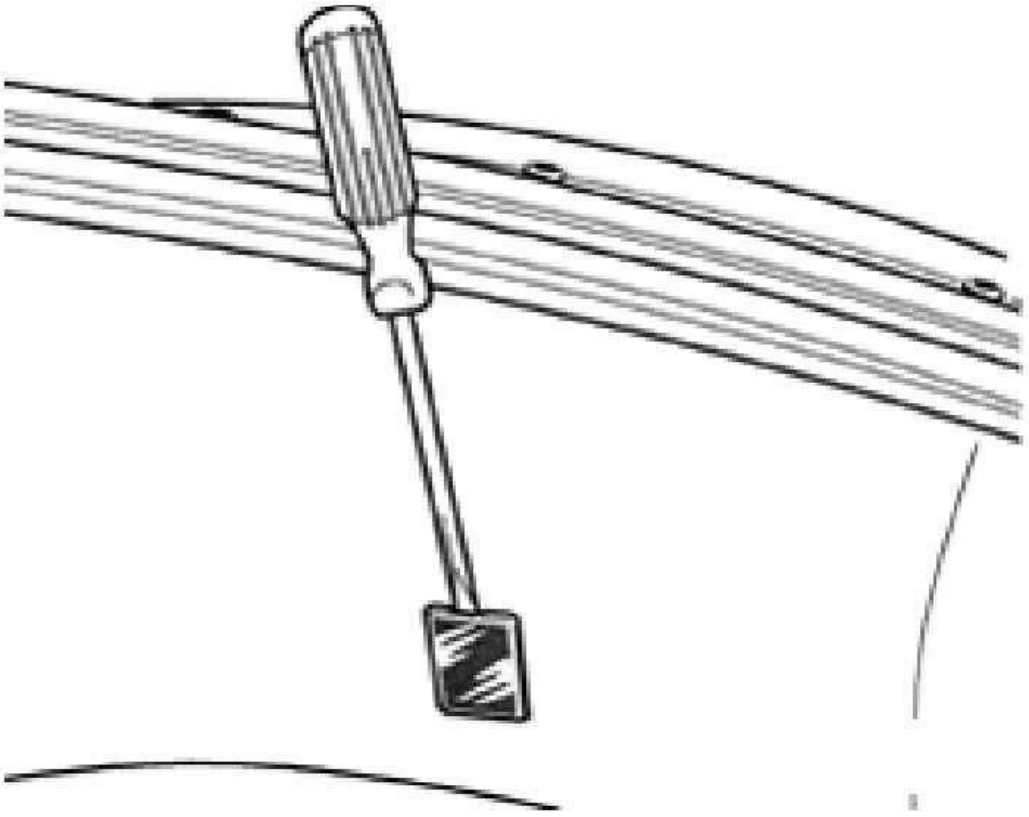


Fig. 64: Identifying Installation Position Of Connecting Rod Bearing Shells
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Bearing shell -1- with oil channel (arrow) for connecting rod

Bearing shell -2- without oil channel connecting rod bearing cap

- Insert bearing shells and connecting rod bearing cap centrally.

  Dimension -a- must be same on both left and right side, maximum deviation 0.2 mm

Checking Cylinder Bores

Fig. 65: Checking Cylinder Bores
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Measuring the cylinder bores must not be done when the cylinder block is mounted on a repair stand with adapter bracket VW 540, as incorrect measurements would then be possible.

Special tools, testers, measuring instruments and auxiliary items required

- Internal dial gauge 50...100 mm
- Measure bores at 3 locations in both directions -A- across engine and -B- in line with crankshaft.

  Deviation from nominal dimension: max. 0.08 mm

Piston and cylinder dimensions

PISTON AND CYLINDER DIMENSIONS SPECIFICATIONS

Honing dimension	Piston diameter	Cylinder bore diameter
Basic dimension mm	82.465(1)	82.51
1st oversize mm	82.965(1)	83.01
(1) Dimensions without graphite coating (thickness 0.02 mm). Graphite coating wears away		

ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD, REMOVING AND INSTALLING CYLINDER HEAD

Checking compression. See **Compression pressures, checking** .

NOTE:

- **When installing an exchange cylinder head with fitted camshaft, lubricate the running contact surfaces between the bucket tappets and the camshaft cam surfaces before installing the cylinder head cover.**
- **The plastic packing pieces for protecting the open valves must not be removed until immediately before installing the cylinder head.**
- **If the cylinder head is replaced, all the coolant in the system must also be replaced.**
- **Removing and installing intake manifold. See INTAKE MANIFOLD UPPER PART, DISASSEMBLING AND .**

Engines with steel cylinder head cover:

- Engine code AEG. See **ENGINES WITH STEEL CYLINDER HEAD COVER**

  Engines with aluminum cylinder head cover.

- Engine codes AVH, AZG, BDC, BEV, BGD. See **ENGINES WITH ALUMINUM CYLINDER HEAD COVER**

Engines with steel cylinder head cover

NOTE: The following list refers to items in Fig. 66 .

1. **Cover**
2. **Seal**
3. **Breather housing**
   - Turn to right to remove
4. **10 N.m**
5. **Seal**
   - Replace if damaged
6. **Retainer**
7. **Sealing plug, 15 N.m**
   - Replace
8. **Seal**
   - Replace
9. **Union**
   - Coolant hose connection diagram. See **COOLANT HOSE CONNECTION DIAGRAM**
10. **Lifting eye**
11. **20 N.m**
12. **Cylinder head gasket**
    - Replace
    - After replacement replace entire coolant amount
13. **15 N.m**
14. **Rear toothed belt guard**
15. **Cylinder head**
    - Check for distortion. See **Fig. 68**
    - Reworking sealing surface. See **Fig. 68**
    - Removing and installing. See **CYLINDER HEAD, REMOVING AND INSTALLING**
    - After replacement replace entire coolant amount
16. **Cylinder head bolt**
    - Replace
    - Remove and install Polydrive cylinder head bolt with 3452
    - Sequence when loosening and tightening. See **CYLINDER HEAD, REMOVING AND INSTALLING**
17. **Oil deflector**
18. **Cylinder head cover gasket**
    - Replace if damaged
    - Coat cylinder head/bearing cap transition points with D 454 300 A2 before installing
19. **Cylinder head cover**

20. **Reinforcing strip**
21. **Rear toothed belt guard, upper part**

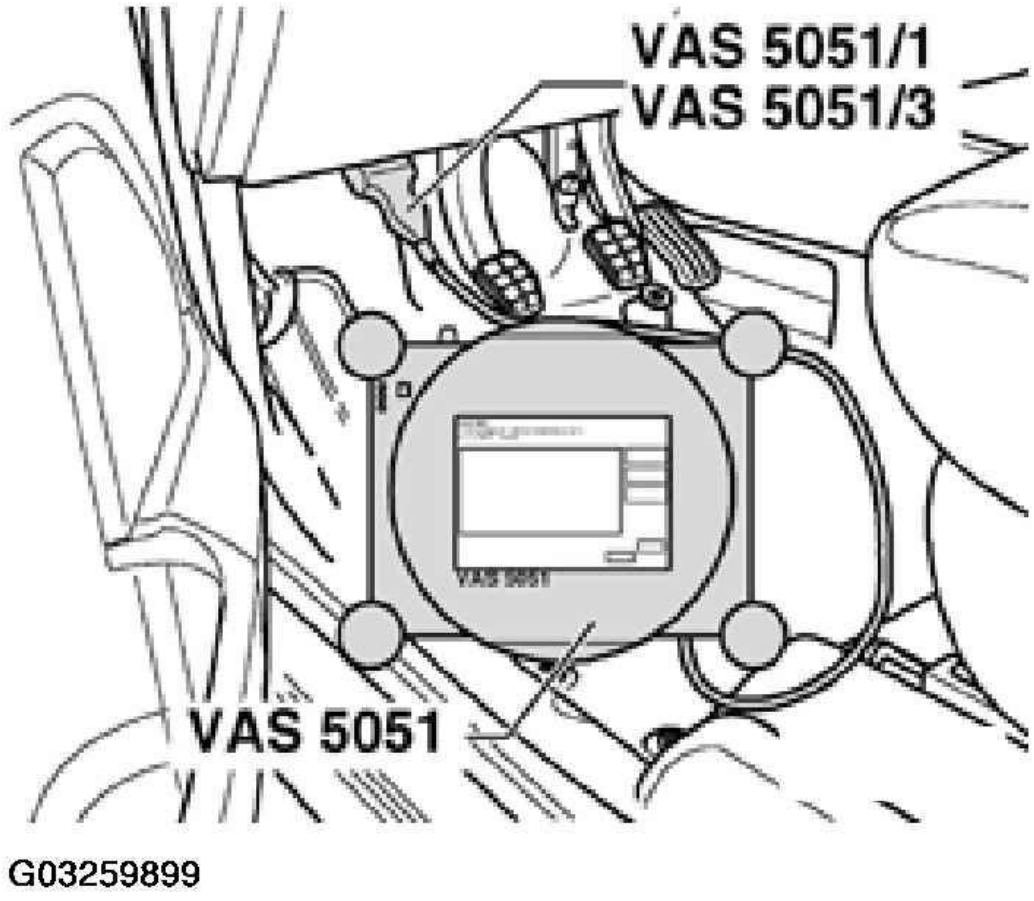


Fig. 66: Exploded View Of Cylinder Head Cylinder Head (Steel Cylinder Head Cover)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engines with aluminum cylinder head cover

NOTE: The following list refers to items in Fig. 67 .

1. **Cover**
2. **Seal**
3. **10 N.m**
4. **To intake manifold**

- Only engine codes BDC, BGD to Positive Crankcase Ventilation (PCV) heating element -N79-

5. **Shaped hose**
   - Engine codes AVH, AZG through Model Year 2001
6. **Shaped hose**
   - Engine codes AVH, AZG from Model Year 2002
   - Engine codes BDC, BEV and BGD
   - Do not remove union between intake manifold hose and shaped hose.
7. **To intake manifold upper part**
   - Only Model Year from 2002
8. **Seal**
   - Replace
9. **Sealing plug, 15 N.m**
   - Replace
10. **Cylinder head bolt**
    - Replace
    - Remove and install Polydrive cylinder head bolt with 3452
    - Sequence when loosening and tightening. See **CYLINDER HEAD, REMOVING AND INSTALLING**
11. **Connecting unions**
    - Coolant hose connection diagram. See **COOLANT HOSE CONNECTION DIAGRAM**
12. **10 N.m**
13. **Seal**
    - Replace
14. **20 N.m**
15. **Lifting eye**
16. **Cylinder head gasket**
    - Replace
    - After replacement replace entire coolant amount
17. **15 N.m**
18. **20 N.m**
19. **Rear toothed belt guard**
20. **Toothed belt**
    - Mark direction of rotation before removing
    - Check for wear
    - Do not kink
    - Removing, installing and tensioning. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING**
21. **Cylinder head**

- Check for distortion. See **Fig. 68**
- Reworking sealing surface. See **Fig. 102**
- Removing and installing. See **CYLINDER HEAD, REMOVING AND INSTALLING**
- After replacement replace entire coolant amount

22. **Oil deflector**
23. **Cylinder head cover gasket**
    - Replace if damaged
    - Coat cylinder head/bearing cap transition points with D 454 300 A2 before installing
24. **Cylinder head cover**
    - With cable guide

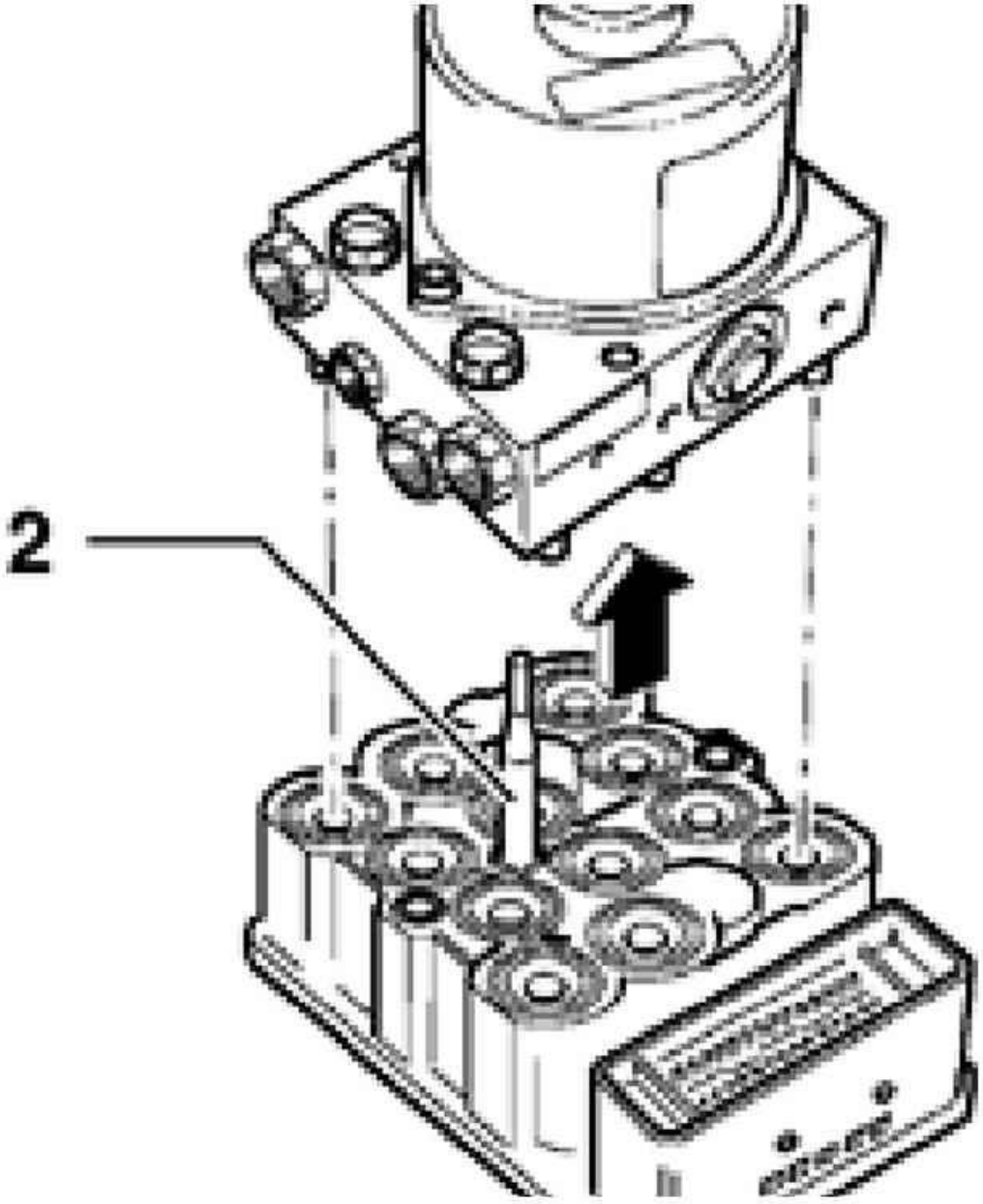


Fig. 67: Exploded View Of Cylinder Head Cylinder Head (Aluminum Cylinder Head Cover)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Cylinder Head For Distortion

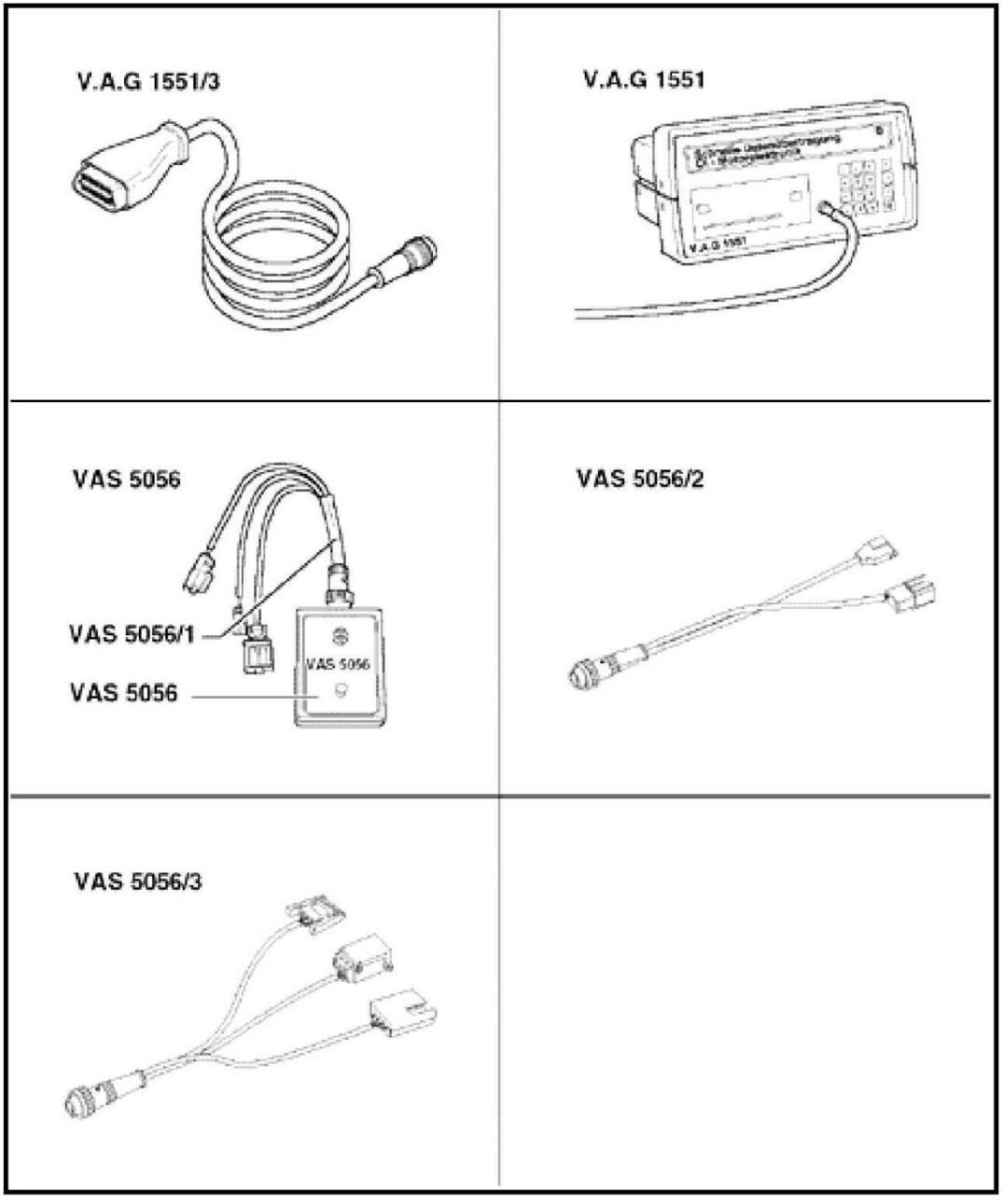


Fig. 68: Checking Cylinder Head For Distortion
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Max. permissible distortion: 0.1 mm

Toothed belts, removing, installing and tensioning

Adjusting valve timing.

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 10-222 A Support device (Modifying guide 10-222 A/21. See **MODIFYING GUIDE 10-222 A/21 FROM SUPPORT DEVICE 10-222 A**)
- 10-222 A/8 Adapter
- V.A.G 1331 Torque wrench (5...50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)
- T 10020 Two-hole pin wrench

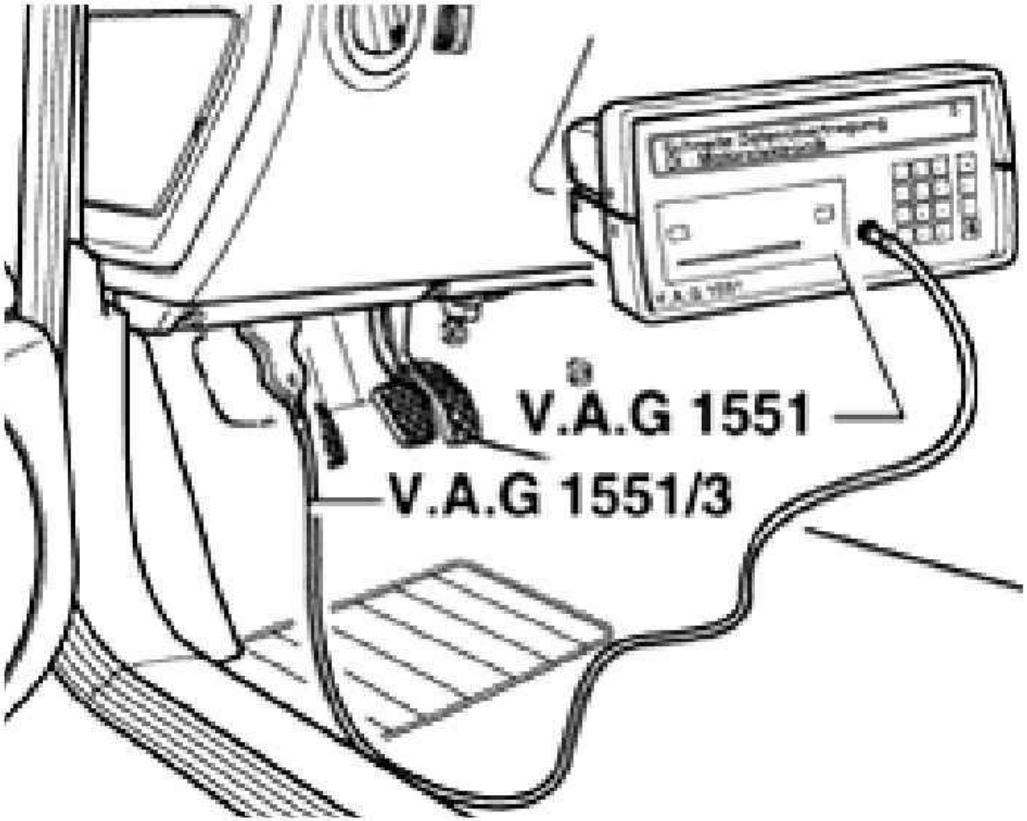


Fig. 69: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Modifying guide 10-222 A/21 from support device 10-222 A

Support device 10-222A is required to support engine/transmission assembly.

A new hole is required on guide 10-222 A/21 to secure adapter 10-222 A/8.

Fig. 70: Identifying 10-222 A/21 & 10-222 A/8
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Dimensions given are in mm.

- Drill a 12.5 mm diameter (arrow) in guide 10-222 A/21.

Removing

- Remove engine cover.
- Removing right side insulation tray:

  See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Remove ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Remove tensioning element for ribbed belt.
- Remove coolant expansion tank (coolant hoses remain connected).
- Remove toothed belt guard, upper part.
- Set camshaft pulley to TDC No. 1 cylinder by turning crankshaft.

  Mark on camshaft sprocket must align with arrow on toothed belt guard

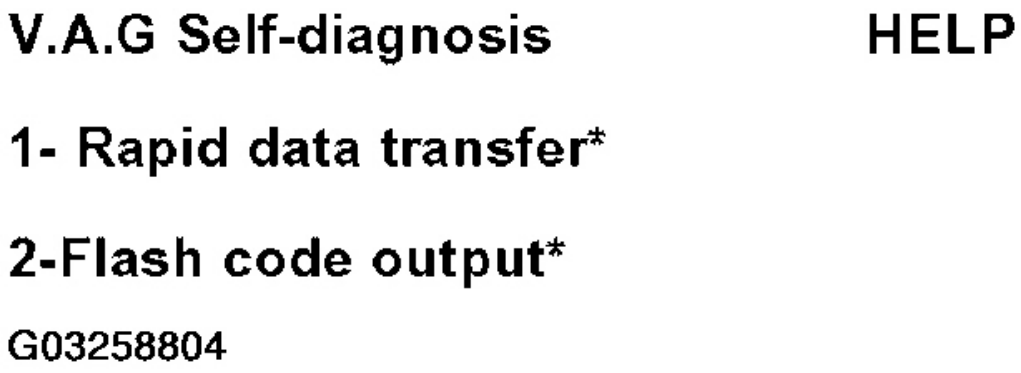


Fig. 71: Aligning Mark On Camshaft Sprocket With Arrow On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Mount support 10-222A with legs 10-222A/8 as shown.

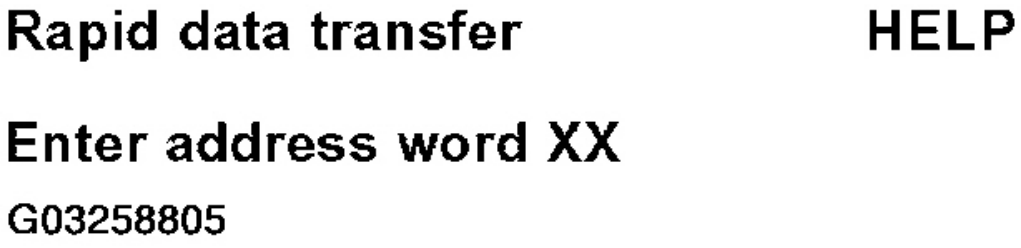


Fig. 72: Mounting Support With Legs On Engine
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove engine mounting -1- as follows:

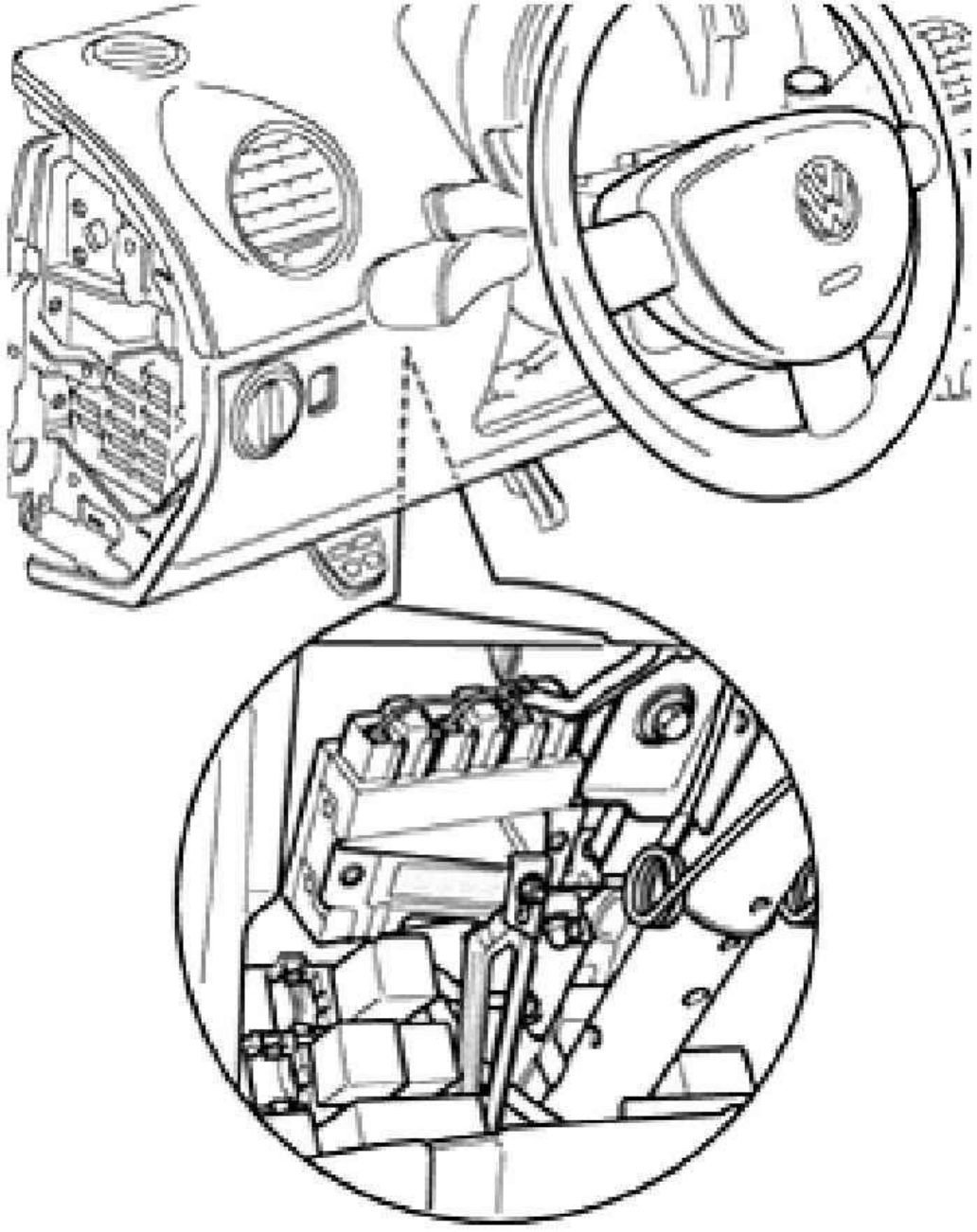


Fig. 73: Removing Engine Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove bolts (arrows).
- Loosen bolt (arrow -A-).

NOTE:

- **Only remove engine mounting when the engine is secured with the support bracket 10-222A.**
- **The engine bracket must be only released when the engine mounting is removed.**

- Remove vibration damper/belt pulley.

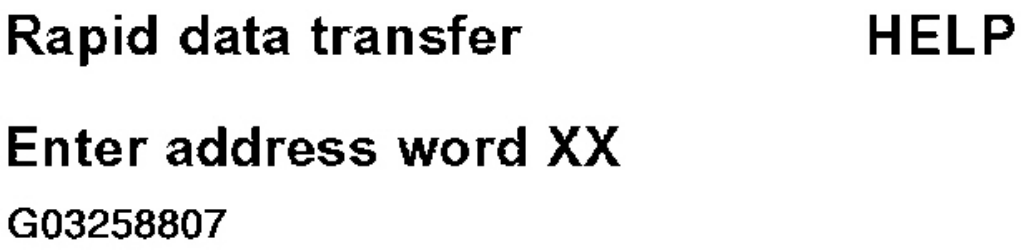


Fig. 74: Removing Vibration Damper/Belt Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove engine bracket from cylinder block.

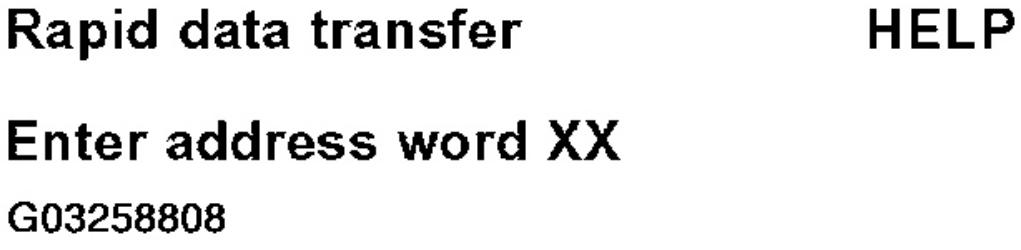


Fig. 75: Removing Engine Bracket From Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: When loosening the front engine mounting bolt the engine must be raised slightly with the support bracket.

- Remove toothed belt guard center and lower parts.
- Mark direction of rotation of toothed belt.
- Release tensioner and take off toothed belt.
- Turn crankshaft back slightly.

Installing

Requirements

- Pistons must not be positioned at TDC.

Work sequence

- Place toothed belt on crankshaft pulley and coolant pump (observe direction of rotation).

NOTE:

- **Engine removed:**

Begin by installing lower section of toothed belt guard as well as belt pulley/vibration damper.

Adjusting valve timing

NOTE: When the camshaft is turned, the crankshaft must not be at TDC. Danger of damage to valves or piston crowns.

- Bring mark on camshaft into line with mark on toothed belt guard.

  Engine installed:

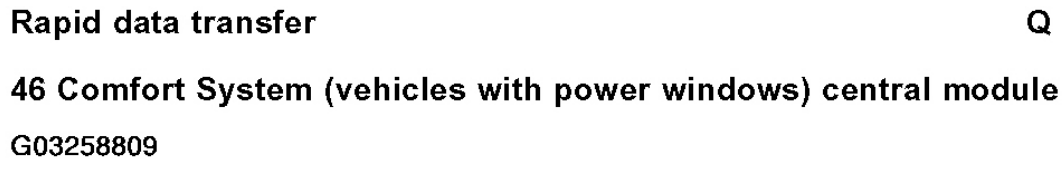


Fig. 76: Aligning Mark On Camshaft With Mark On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to TDC No. 1 cylinder (vehicles with manual transmission).

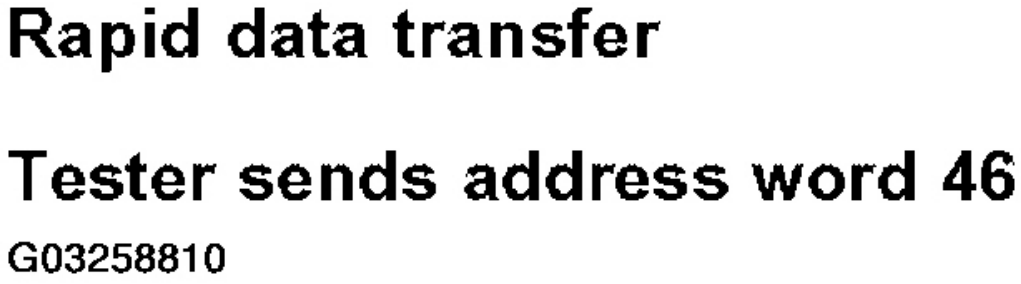


Fig. 77: Locating Mark For Positioning TDC No. 1 Cylinder (Vehicles With Manual Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to TDC No. 1 cylinder (vehicles with automatic transmission).

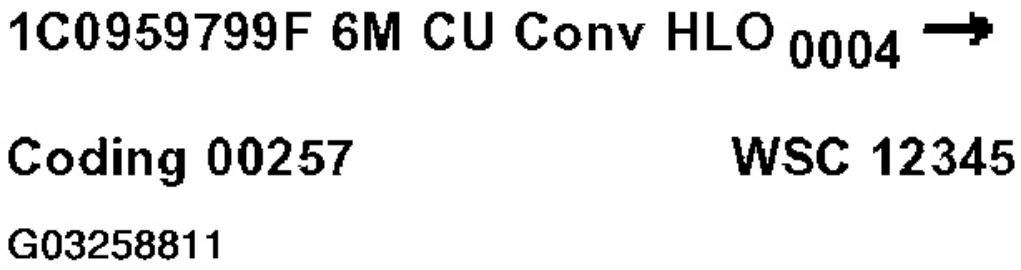


Fig. 78: Locating Mark For Positioning TDC No. 1 Cylinder (Vehicles With Automatic Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine removed:

- Position vibration damper at TDC No. 1 cylinder (arrows).

Fig. 79: Positioning Vibration Damper At TDC No. 1 Cylinder
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Place toothed belt on tensioning roller and camshaft pulley.

Tensioning toothed belt

Requirements

- Engine must only be hand touch warm.
- Camshaft sprocket is at TDC No. 1 cylinder.
- Before tensioning toothed belt, turn tensioning roller on eccentric with pin wrench T10020 five times fully onto limit stops in both directions.

Work sequence

- Tension toothed belt by turning eccentric to left (direction of arrow) with 2-hole pin wrench T10020 onto limit stop.

Fig. 80: Tensioning Toothed (Timing) Belt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Release tension on toothed belt until notch -1- and indicator -2- align (use mirror).
- Tighten securing nut to 20 N.m.

- Turn crankshaft two turns in engine direction of rotation until engine is again at TDC No. 1 cylinder. Last 45° (1/8 turn) must be completed without stopping.
- Check toothed belt tension again.

  Specification: Indicator and notch align

Continuation, install complete toothed belt

- Install toothed belt guard center and lower parts.
- Install vibration damper/belt pulley.

  Tightening torque: 25 N.m

- Install engine mounting to cylinder block.

  Tightening torque: 45 N.m

- Install engine assembly mountings complete.

  NOTE: Insert bolts into engine bracket before installing engine bracket.

- Align assembly mountings for engine and transmission. See **ENGINE AND TRANSMISSION MOUNTINGS, ALIGNING** .

  Tightening torques. See **ASSEMBLY MOUNTING** .

- Remove engine support bracket 10-222 A.
- Install toothed belt guard, upper part.
- Install ribbed belt tensioning element.

  Tightening torque: 25 N.m

- Install ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Install coolant expansion tank.
- Install right side sound insulation tray:

  See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Install engine cover.

Semi-automatic toothed belt tensioning roller, checking

Special tools, testers, measuring instruments and auxiliary items required

- T10020 Two hole pin wrench

Fig. 81: Identifying T10020 Two Hole Pin Wrench
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installed position

- Angled retainer (arrow) must locate in cutout on cylinder head.

Fig. 82: Locating Semi-Automatic Toothed Belt Tensioning Roller Angled Retainer
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirements

- Engine must only be hand touch warm.

Work sequence

- Set engine to TDC No. 1 cylinder.
- Press hard with thumb on toothed belt. Indicator -2- must move.

Fig. 83: Tensioning Toothed Belt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Release thumb pressure on toothed belt and turn crankshaft two turns in engine direction of rotation until engine is again at TDC No. 1 cylinder. Last 45° (1/8 turn) must be performed without stopping.

  Tensioning roller must return to its original position (notch -1- and indicator -2- are again aligned).

NOTE: Use a mirror when checking.

Cylinder head, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- V.A.G 1306 Drip tray
- V.A.G 1332 Torque wrench (40...200 N.m)
- VAS 5024 Assembly tool for spring-type clips
- 3450/2A Guide pins
- 3450/3 Removal tool
- 3452 Key

Fig. 84: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- T10112 Installation tool

Fig. 85: Identifying T10112 Installation Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirements

- Engine must only be hand touch warm.

Work sequence

CAUTION: When performing repair work, especially due to the confined conditions in the engine compartment, pay attention to the following:

- **Route all types of lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum) as well as electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

NOTE: During the further course of work the battery Ground strap must be disconnected. Therefore, please check whether a coded radio is installed. Obtain the radio code first if necessary.

- With ignition switched off disconnect battery Ground strap.
- Remove engine cover.
- Drain coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .
- Observe rules for cleanliness. See **RULES FOR CLEANLINESS** .

WARNING:

- **Fire Hazard! Do NOT have anything in the area that can ignite fuel!**
- **Fuel system is under pressure! Before opening the system**

place a cloth around the connection. Then release pressure by carefully loosening the connection.

Engine codes AEG, AVH, AZG

- Pull fuel supply line -3-, fuel return line -2- and vacuum line -1- off at connecting point.

Fig. 86: Removing Fuel Supply Line, Fuel Return Line And Vacuum Line (Engine codes AEG, AVH, AZG)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Disconnect hose from EVAP canister purge regulator valve -N80-.
- Disconnect fuel supply line -1- and fuel return line -2- from fuel rail and collect fuel that leaks out with a clean cloth.

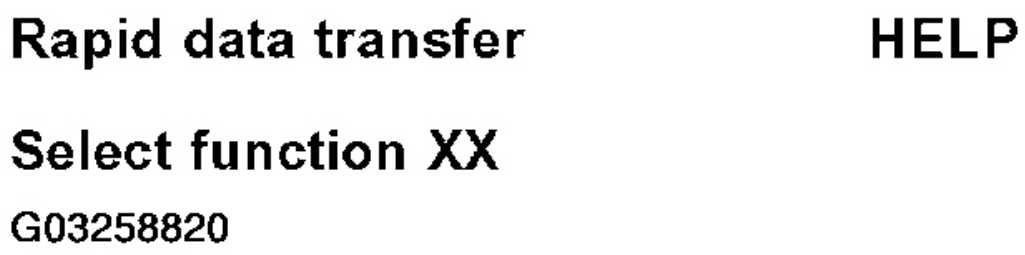


Fig. 87: Disconnecting Fuel Supply Line And Fuel Return Line From Fuel Rail (Engine Codes AEG, AVH, AZG)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine code BDC

- Disconnect fuel supply line -1- and fuel return line -2- at connection point on fuel rail.

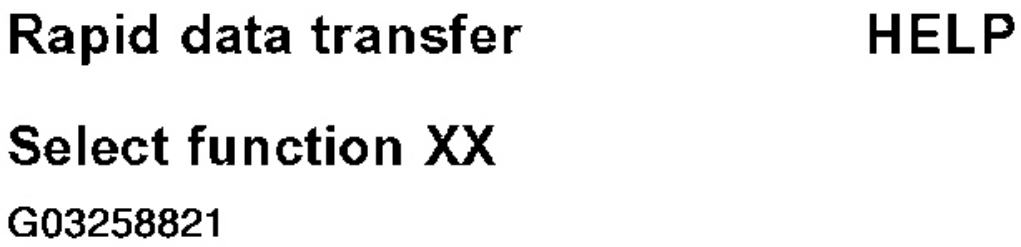


Fig. 88: Disconnecting Fuel Supply Line And Fuel Return Line (Engine Code BDC)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Disconnect hose from EVAP canister purge regulator valve -N80-.

Engine codes BEV, BGD

- Pull fuel supply line -1- off union by pressing locking ring -2- into union -3- and collect fuel that leaks out with a clean cloth.

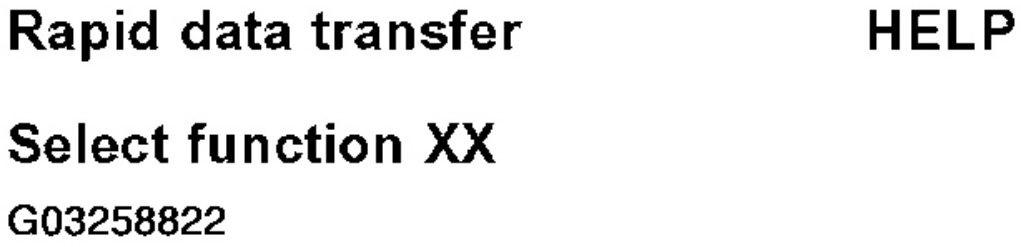


Fig. 89: Disconnecting Fuel Supply Line (Engine Codes BEV, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Continuation for all models

- Seal lines to avoid contamination of fuel system.
- Remove air cleaner assembly complete with air intake tube and secondary air injection tube. See **AIR CLEANER, DISASSEMBLING AND ASSEMBLING**
- Remove intake manifold upper part: See **INTAKE MANIFOLD UPPER PART, REMOVING AND INSTALLING**

NOTE: Seal the intake ports in the intake manifold lower section with clean cloths.

- Release all coolant, vacuum and intake hoses from intake manifold/cylinder head as required.
- Pull off/disconnect all electrical wiring as necessary on cylinder head and place to side.
- Disconnect coolant hose at connecting unions.
- Remove intake and pressure lines for secondary air injection pump.
- Remove pressure line bracket.
- Unbolt and remove secondary air injection pump motor and bracket.
- Disconnect following connectors:
  - -1- for Secondary Air Injection (AIR) pump motor -V101-, -2-

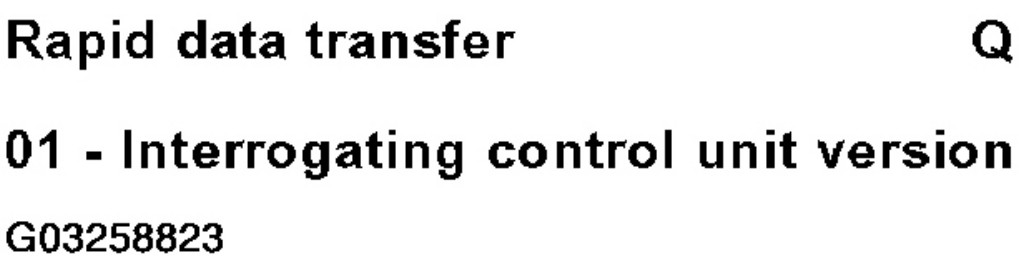


Fig. 90: Disconnecting Secondary Air Injection (AIR) Pump Motor Connector
Courtesy of VOLKSWAGEN OF AMERICA, INC.

  - For Camshaft Position (CMP) sensor -G40-
  - For Knock Sensor (KS) 1 -G61-
  - For injectors -N30-, -N31-, -N32-, -N33- (release from cable guide).
  - Engine Coolant Temperature (ECT) sensor -G62- (arrow).
- Remove harness for Knock Sensor 1 -G61- from clip on Generator bracket.

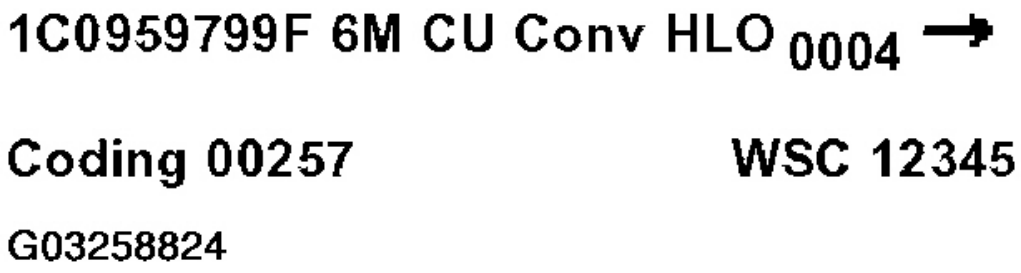


Fig. 91: Disconnecting Engine Coolant Temperature (ECT) Sensor Connector
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove clips securing fuel injector harness to fuel rail and place harness to side.
- Unclip wiring harness from left side of cylinder head.
- Remove ignition cables from spark plugs (use T10112).
- Unclip coolant recovery hose from bracket -1- on top of toothed belt tensioner.
- Remove bolt -2- securing oil dipstick tube to lower intake manifold.

Fig. 92: Removing Coolant Recovery Hose Clip
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove cover from oxygen sensor connectors on vehicle underside. See IDENTIFYING PIN CONNECTOR OF HEATED OXYGEN SENSOR under **ENGINE CODE BEV**
- Disconnect Heated Oxygen Sensor (HO2S) -G39- connector and unclip harness from exhaust heat shield.
- Remove front exhaust pipe with catalytic converter.
- Remove ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Remove tensioning element for ribbed belt.

- Remove bracket (item - 4 -. See **PART I**) on tensioning element for ribbed belt.
- Remove toothed belt guard, upper part.
- Set camshaft pulley to TDC No. 1 cylinder by turning crankshaft.

  Mark on camshaft sprocket must align with arrow on toothed belt guard

Fig. 93: Aligning Mark On Camshaft Sprocket With Arrow On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Release tensioning roller and take toothed belt off camshaft pulley.
- Turn crankshaft back slightly.
- Remove cylinder head cover.
- Remove upper rear toothed belt guard bolt.
- Loosen socket head bolts in sequence given and then remove complete.

NOTE: Use tool 3452 for Polydrive cylinder head bolts.

Fig. 94: Loosening Sequence Of Cylinder Head Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully lift cylinder head off.

Installing

NOTE:

- **Always replace cylinder head bolts.**
- **There must be no oil or coolant in the cylinder head bolt pockets in the cylinder head.**
- **Only remove the new cylinder head gasket from its packing immediately before installing.**
- **Handle the new gasket with extreme care. Damage will lead to leaks.**

- Place a clean cloth into cylinders so that no dirt or emery cloth particles can get in between cylinder wall and piston.
- Prevent dirt and emery cloth particles from getting into coolant.
- Carefully clean cylinder head and cylinder block sealing surfaces. Please ensure that no scoring or scratches are formed (when using abrasive paper grade must not be less than 100).
- Carefully remove metal particles, emery remains and cleaning cloths.
- If crankshaft has been turned: Set No. 1 cylinder piston to top dead center and then turn crankshaft back slightly.
- To centralize, screw guide pins from 3450/2A into front outer holes for cylinder head bolts.

Fig. 95: Centralizing Guide Pins
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install new cylinder head gasket.

NOTE: Lettering (part number) must be readable.

- Install cylinder head, thread in 8 remaining cylinder head bolts and tighten by hand.
- Remove guide pins through bolt holes with extractor 3450/3. Extractor must be turned to left (counter-clock wise) until pins are free.
- Install remaining cylinder head bolts and tighten hand-tight.
- Tighten cylinder head bolts in prescribed tightening sequence as follows:
  - Pretighten all bolts to 40 N.m.
  - Then tighten all bolts 1/4 turn (90°) turn further with a rigid wrench.

- Then tighten all bolts again 1/4 turn (90°) further.

Fig. 96: Tightening Sequence Of Cylinder Head Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

The rest of the assembly is basically in reverse order to the disassembly sequence.

NOTE: When the camshaft is turned, the crankshaft must not be at TDC. Danger of damage to valves or piston crowns.

- Install cylinder head cover and tighten nuts.

  Tightening torque: 10 N.m

- Install toothed belt and adjust timing. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .
- Install ribbed belt tensioning element.

  Tightening torque: 25 N.m

- Install ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .

NOTE: All cable ties which are opened or cut open to remove the cylinder head must be replaced in the same position when re-installing the cylinder head.

- Fill with new coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .
- Connect battery Ground (GND) strap.

Vehicles without EPC

- Adjust accelerator cable. See **ACCELERATOR MECHANISM, SERVICING** .

Continuation for all models

- Adapt (match) engine control module to throttle valve control module. See **COMPONENTS AND FUNCTIONS, ADAPTING** .
- Road test vehicle and interrogate all fault memories:

  Observe the valid safety precautions when performing a road test. See **SAFETY PRECAUTIONS** .

- If fault memory has been erased or engine control module was disconnected from permanent positive, respective components must be adapted to engine control module and readiness code generated again. See **COMPONENTS AND FUNCTIONS, ADAPTING** .
- Read readiness code.

Vehicles with automatic transmission

- Adapt transmission control module:

  For 01M, see **BASIC SETTING, INITIATING** .

  For 09G, see **BASIC SETTING, INITIATING** .

- Test drive vehicle and interrogate fault memory.

COMPRESSION PRESSURES, CHECKING

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 3122 B Spark plug wrench
- T10112 Removal tool
- V.A.G 1331 Torque wrench (5..50 N.m)
- V.A.G 1763 Compression tester

Fig. 97: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirements

- Engine oil temperature must be at least 30°C.
- Voltage supply OK.
- All electrical consumers, e.g. lights and rear window defogger must be switched off.
- If the vehicle is equipped with air conditioning, this must be switched off.
- On models with an automatic transmission selector lever in position "P" or "N"

Work sequence

- Remove engine cover.
- Disconnect 6-pin connector from ignition coil with final output stage (arrow).

  Engine code AEG

Fig. 98: Locating Engine Code AEG
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine codes AVH, AZG, BDC, BEV, BGD

Fig. 99: Locating Engine Codes AVH, AZG, BDC, BEV, BGD
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pull fuse No. 32 out of fuse holder. Fuse box located under access cover at far left end of dash.

NOTE: Removing the fuse interrupts the voltage supply to the injectors.

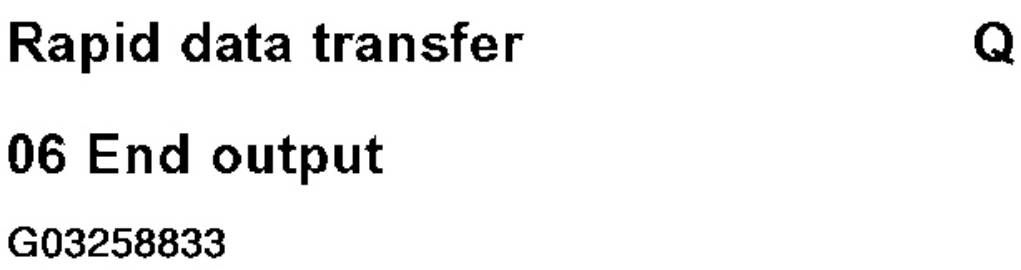


Fig. 100: Locating Fuses
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Disconnect connectors for outer injectors.
- Disconnect spark plug connectors with tool T10012
- Remove spark plugs with spark plug wrench 3122B.
- Check compression pressures using compression tester V.A.G 1763 and adapter V.A.G 1763/6.

NOTE: To use the compression tester. See Operating instructions.

Vehicles without EPC

- Have a second technician fully depress accelerator pedal.

Continuation for all models

- Have a second technician operate starter motor.
- Operate starter until tester shows no further pressure increase.

Compression pressure values

New: 10...13 bar

Wear limit: 7.5 bar

Permissible difference between all cylinders: 3 bar

- Adapt (match) engine control module to throttle valve control module. See **COMPONENTS AND FUNCTIONS, ADAPTING** .

- If fault memory has been erased or engine control module was disconnected from permanent positive, respective components must be adapted to engine control module and readiness code generated again. See **COMPONENTS AND FUNCTIONS, ADAPTING** .

VALVE GEAR, SERVICING

NOTE:

- **Cylinder heads which have cracks between the valve seats or between valve seat inserts and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first four spark plug threads are cracked.**
- **When new lifters have been installed the engine must not be started for about 30 minutes. (Otherwise valves will contact pistons) Then, finally, rotate crankshaft two complete revolutions.**

NOTE: The following list refers to items in Fig. 101 .

1. **100 N.m**
   - Use counter support tool 3415 to loosen and tighten
2. **Camshaft pulley**
3. **Seal**
   - Replacing. See **CAMSHAFT OIL SEAL, REPLACING**
4. **Woodruff key**
   - Check if seated securely
5. **20 N.m**
6. **Bearing cap**
   - Installation position. See **Fig. 104**
   - Installation sequence. See **CAMSHAFT, REMOVING AND INSTALLING**
   - Coat contact surfaces of bearing cap 1 lightly with sealing compound AMV 174 004 01.
7. **Camshaft**
   - Checking axial clearance. See **Fig. 103**
   - Removing and installing. See **CAMSHAFT, REMOVING AND INSTALLING**
   - Check radial clearance with Plastigage, Wear limit: 0.1 mm
   - Run-out: max. 0.05 mm
8. **Hydraulic lifter**
   - Do not interchange
   - With hydraulic valve clearance compensation
   - Checking. See **HYDRAULIC LIFTERS, CHECKING**
   - Store with cam contact surface downward
   - Before installing check camshaft axial clearance. See **Fig. 103**

- Oil contact surface

9. **Keepers**
10. **Valve spring upper plate**
11. **Valve spring**
    - Removing and installing with cylinder head removed: With 2037; with cylinder head installed: See **VALVE STEM SEALS, REPLACING**
12. **Valve stem seal**
    - Replacing. See **VALVE STEM SEALS, REPLACING**
13. **Valve guide**
    - Checking. See **VALVE GUIDES, CHECKING**
    - Replacing. See **VALVE GUIDES, REPLACING**
    - Repair version with shoulder
14. **Cylinder head**
    - Reworking sealing surface. See **Fig. 102**
    - Reworking valve seats. See **VALVE SEATS, REWORKING**
15. **Valves**
    - Do not rework, only lapping is permitted
    - Valve dimensions. See **Fig. 105**

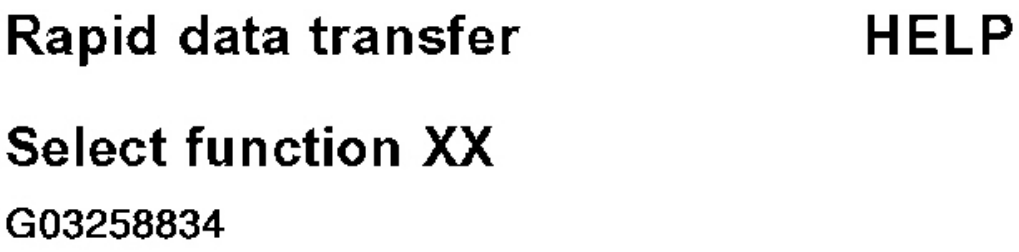


Fig. 101: Disassembled View Of Valve Gear
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Reworking cylinder head sealing surface

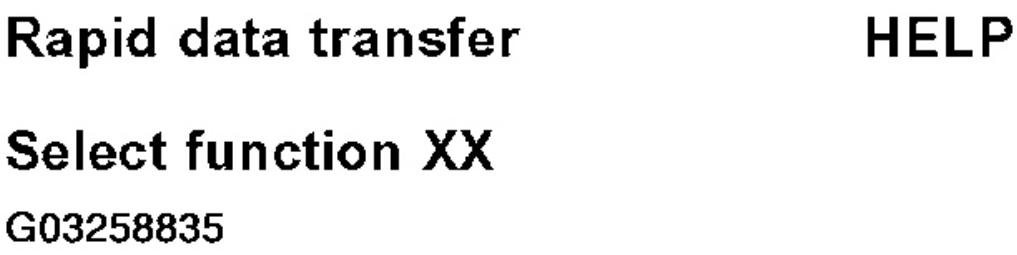


Fig. 102: Identifying Cylinder Head Reworking Dimension (Cylinder Head Height)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Cylinder head reworking dimension: -a- = min. 132.6 mm

NOTE: When the sealing surface has been reworked, the valves must be set deeper by the same amount.

Checking Camshaft Axial Clearance

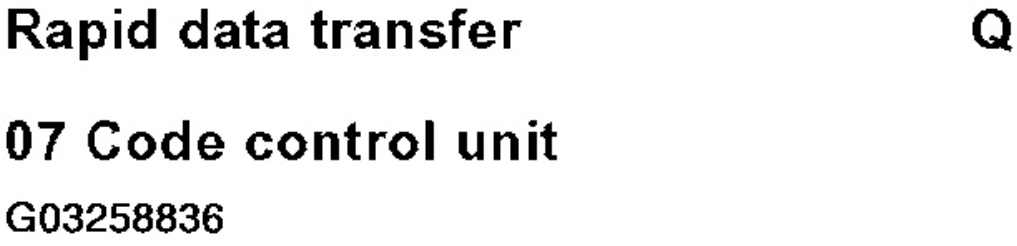


Fig. 103: Checking Camshaft Axial Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools, testers, measuring instruments and auxiliary items required

- Universal dial gauge bracket VW 387
- Dial gauge

Check with hydraulic lifters removed and with first and last bearing caps installed.

Wear limit: max. 0.15 mm

Installed position of camshaft bearing caps

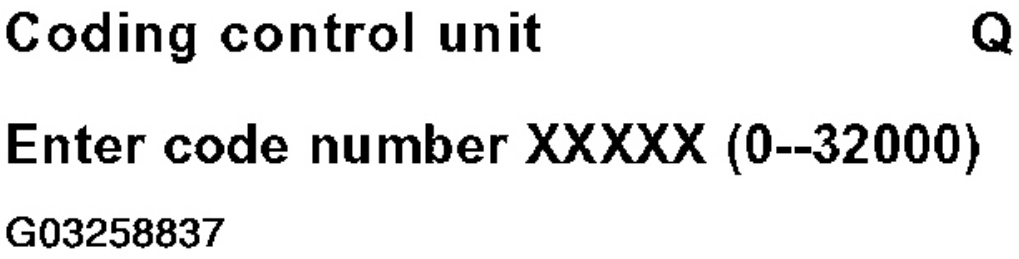


Fig. 104: Identifying Installed Position Of Camshaft Bearing Caps
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Note offset. Before installing camshaft fit bearing caps and determine installed position.

Valve dimensions

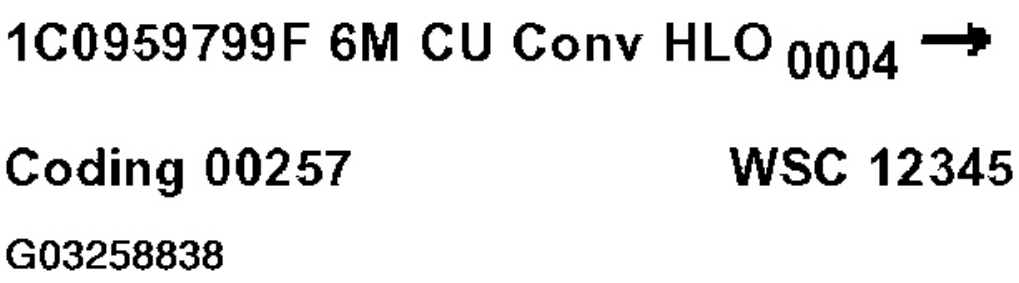


Fig. 105: Identifying Valve Dimensions
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Valves must not be reworked. Only lapping is permitted.

Engine code AEG

VALVE DIMENSIONS SPECIFICATIONS (ENGINE CODE AEG)

Dimension	Intake valve	Exhaust valve
Dia. a -	39.5 +/- 0.15	32.9 +/- 0.15
Dia. b - mm	6.92 + 0.02	6.92 + 0.02
Length c - mm	91.85	91.15
Angle a - degrees	45	45

Engine codes AVH, AZG, BDC, BEV, BGD

VALVE DIMENSIONS SPECIFICATIONS (ENGINE CODES AVH, AZG, BDC, BEV, BGD)

Dimension	Intake valve	Exhaust valve
Dia. a - mm	39.5 +/- 0.15	32.9 +/- 0.15
Dia. b - mm	6.98 +/- 0.007	6.96 +/- 0.007
Length c - mm	91.85	91.15
Angle a - degrees	45	45

Valve seats, reworking

Special tools, testers, measuring instruments and auxiliary items required

- Depth gauge
- Valve seat refacing tool

NOTE:

- **When repairing engines with leaking valves, it is not sufficient to rework or replace valve seats and valves. It is also necessary to check the valve guides for wear. This particularly important on high mileage engines.**
- **The valve seats should only be reworked just enough to produce a perfect seating pattern. The maximum permissible reworking dimension must be calculated before reworking commences. If the reworking dimension is exceeded, the function of the hydraulic lifters can no longer be guaranteed and the cylinder head should be replaced.**

Calculating maximum permissible reworking dimension

- Insert valve and press firmly against seat.

NOTE: **If the valve is to be replaced as part of a repair, use a new valve for the measuring.**

- Measure distance -a- between end of valve stem and upper edge of cylinder head.

Fig. 106: Measuring Distance Between End Of Valve Stem And Upper Edge Of Cylinder Head
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Calculate maximum permissible reworking dimension from measured distance -a- and minimum dimension.

  Minimum dimensions:

  Intake valve 33.8 mm

  Exhaust valve 34.1 mm

Measured distance -a- minus minimum dimension = maximum permissible reworking dimension.

Example:

CALCULATING MAXIMUM PERMISSIBLE REWORKING DIMENSION (EXAMPLE)

Measured distance -a-	35.1 mm
Minimum dimension - 34.1	mm
= max. perm. Rework dimension (1)	1.0 mm
(1) The maximum permissible reworking dimension is shown as dimension "b" in illustrations for reworking of valve seats.	

Reworking intake valve seat

INTAKE VALVE SEAT DIMENSION SPECIFICATIONS

Dimension	**Intake valve seat**
Dia. a - mm	39.2
b - mm	max. permissible reworking dimension
c - mm	1.8...2.2

Z	Cylinder head lower edge
45°	Valve seat angle
30°	Upper correction angle

Fig. 107: Reworking Intake Valve Seat
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Reworking exhaust valve seat

EXHAUST VALVE SEAT DIMENSION SPECIFICATIONS

Dimension	**Exhaust valve seat**
Dia. a - mm	32.4
Dia. b - mm	max. permissible reworking dimension
c - mm	2.2...2.6
Z	Cylinder head lower edge
45°	Valve seat angle
30°	Upper correction angle

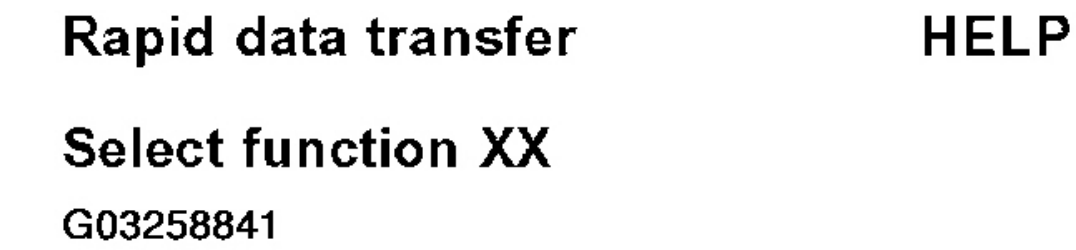


Fig. 108: Reworking Exhaust Valve Seat
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Camshaft oil seal, replacing

For coil spring seals:

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 10-203 Puller
- 2085 Oil seal extractor
- 3415 Counterhold
- V.A.G1331 Torque wrench (5 ... 50 N.m)
- V.A.G 1332 Torque wrench (40 ... 200 N.m)

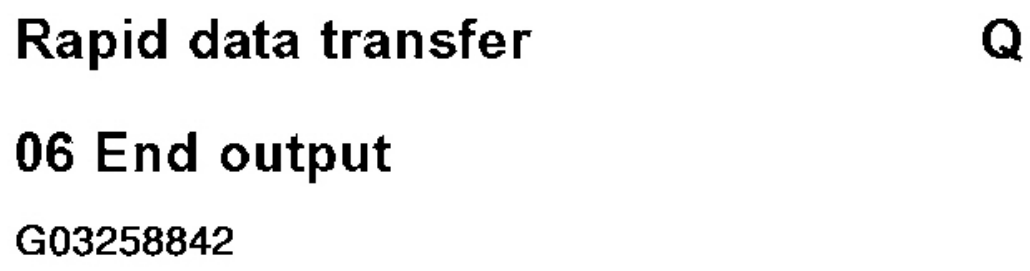


Fig. 109: Identifying Special Tools (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

For PTFE seals:

- 2085 Oil seal extractor
- 3415 Counter support
- T10071 Puller
- V.A.G 1331 Torque wrench (5..50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)

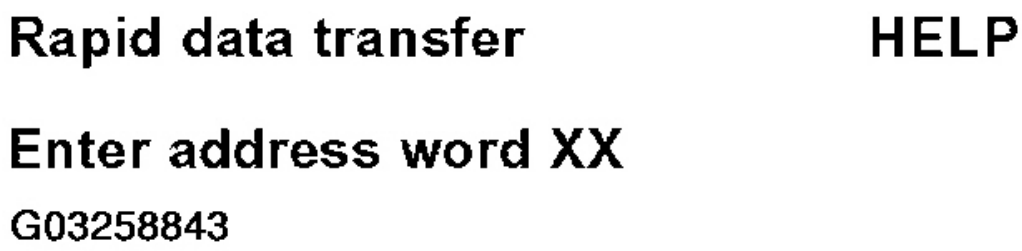


Fig. 110: Identifying Special Tools (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove toothed belt guard, upper part.
- Set camshaft pulley to TDC No. 1 cylinder by turning crankshaft.

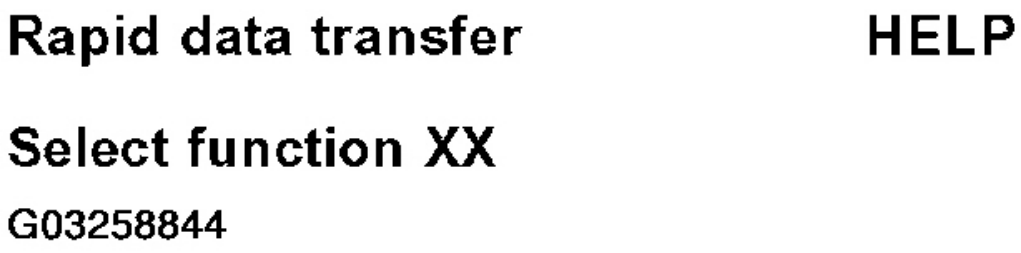


Fig. 111: Aligning Mark On Camshaft Sprocket With Arrow On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Mark on camshaft sprocket must align with arrow on toothed belt guard

- Release tensioning roller and take toothed belt off camshaft pulley.
- Turn crankshaft back slightly.
- Remove camshaft pulley. To loosen camshaft pulley securing bolt, hold pulley with counter support 3415

Fig. 112: Removing Camshaft Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove woodruff key from camshaft.
- Screw camshaft pulley securing bolt fully into camshaft onto limit stop.
- Unscrew inner part of oil seal extractor 2085 two turns (approx. 3 mm) out of outer part and lock in position with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure screw it into oil seal as far as possible.

Fig. 113: Removing Camshaft Oil Seal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.
- Clamp flats of oil seal extractor in a vice. Remove oil seal with pliers.

Installing

Requirements

- Pistons must NOT be positioned at TDC.

NOTE: A PTFE seal (Teflon) -2 is gradually being introduced instead of the inner coil spring seal -1-. This has a wider sealing lip. PTFE oil seals are installed free of oil and grease. A radial shaft seal of older design (with coil spring) may be replaced with a PTFE oil seal, but not vice versa. When a PTFE oil seal is installed, then only such an oil seal may be installed as a replacement part!

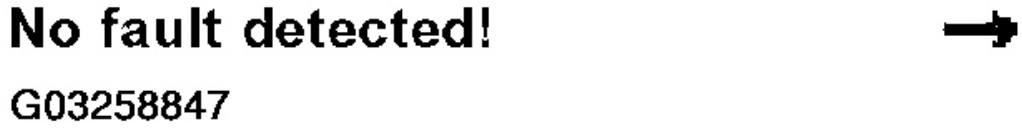


Fig. 114: Identifying Oil Seals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

PTFE sealing rings

NOTE: Do not additionally oil or grease the oil seal sealing lip.

- Position oil seal with guide sleeve T10071 and press in onto limit stop with press sleeve T10071/1 and bolt T10071/2.

Coil spring seals

NOTE: Oil or grease lightly the oil seal sealing lip.

- Position oil seal with guide sleeve 10-203 and press in onto limit stop with press sleeve and bolt from 10-203.

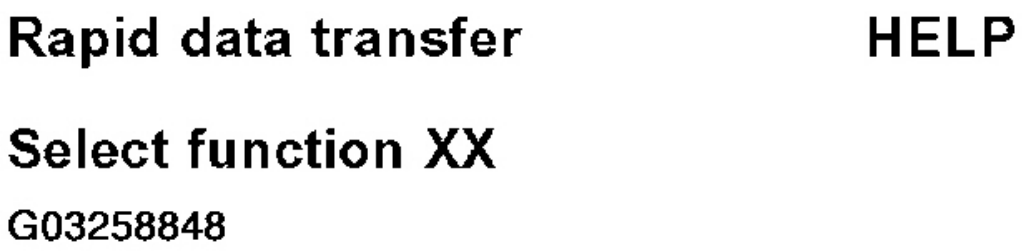


Fig. 115: Installing Cam Shaft Oil Seal With Guide Sleeve
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Continuation for all seals

- Insert woodruff key in camshaft.
- Install camshaft pulley. To tighten securing bolt counter support camshaft pulley with 3415.

  Tightening torque: 100 N.m

  NOTE: When the camshaft is turned, the crankshaft must not be at TDC. Danger of damage to valves or piston crowns.

  The rest of the assembly is basically in reverse order to the disassembly sequence.

Fig. 116: Installing Camshaft Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing toothed belt and adjusting timing. See **TOOTHED BELTS, REMOVING, INSTALLING**

AND TENSIONING .

Camshaft, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 3415 Counter support
- V.A.G 1331 Torque wrench (5...50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)
- AMV174 004 01 Sealant

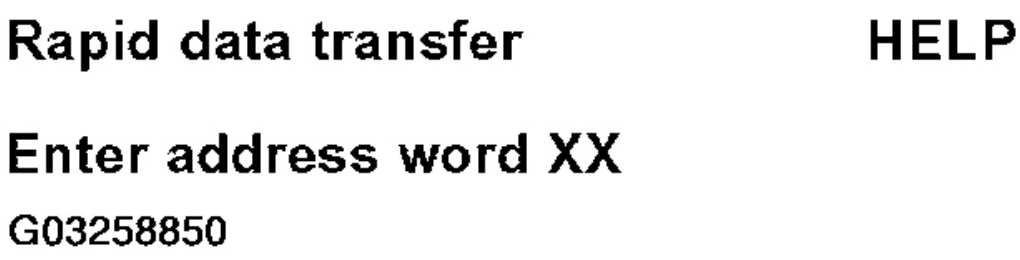


Fig. 117: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove engine cover.
- Remove intake manifold upper part. See **INTAKE MANIFOLD UPPER PART, REMOVING AND INSTALLING** .

NOTE: Seal the intake ports in the intake manifold lower section with clean cloths.

- Remove toothed belt guard, upper part.
- Set camshaft pulley to TDC No. 1 cylinder by turning crankshaft.

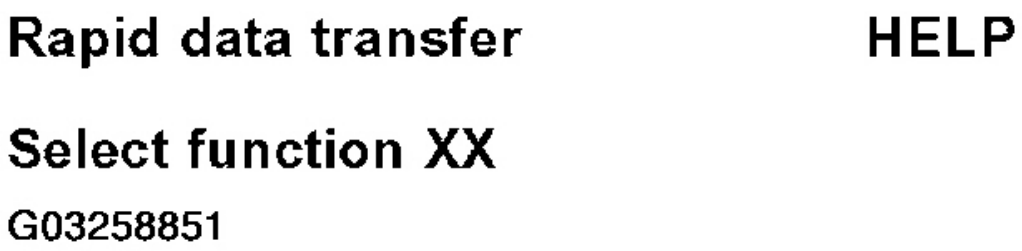


Fig. 118: Aligning Mark On Camshaft Sprocket With Arrow On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Mark on camshaft sprocket must align with arrow on toothed belt guard.

- Release tensioning roller and take toothed belt off camshaft pulley.
- Turn crankshaft back slightly.
- Remove camshaft pulley. To loosen camshaft pulley securing bolt, hold pulley with counter support 3415

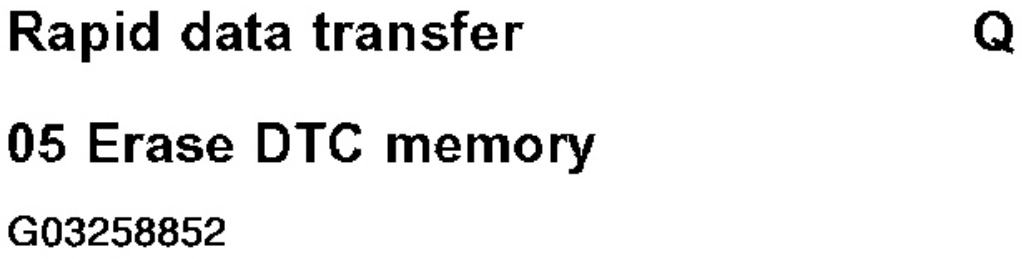


Fig. 119: Removing Camshaft Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove woodruff key from camshaft.
- Remove cylinder head cover.
- First remove bearing caps 5, 1 and 3. Loosen bearing caps 2 and 4 alternately and diagonally.

Installing

Requirements

- Pistons must not be positioned at TDC.

NOTE:

- **When installing the camshaft, the cam lobes for cylinder 1 must face upward.**
- **When installing the bearing cap note offset. Before installing camshaft fit bearing caps and determine installed position.**

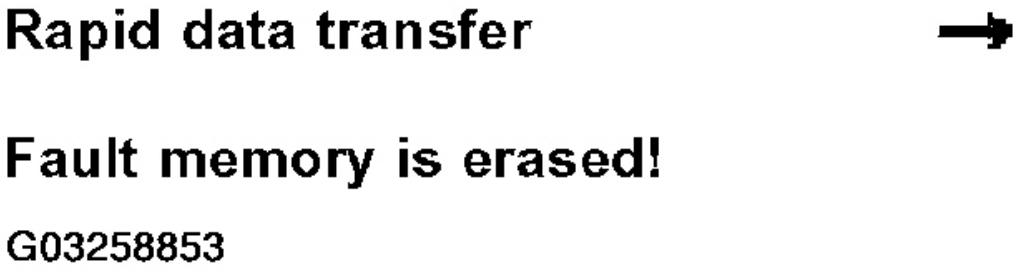


Fig. 120: Identifying Correct Installation Of Camshaft Bearing Cap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Work sequence

- Oil running surfaces on camshaft.
- Install camshaft.
- Tighten bearing caps 2 and 4 alternately and diagonally to 20 N.m.
- Coat contact surfaces of bearing cap 1 lightly with sealing compound AMV 174 004 01.
- Install bearing caps 3, 1 and 5 and also tighten to 20 N.m.
- Insert woodruff key in camshaft.
- Install camshaft pulley. To tighten securing bolt counter support camshaft pulley with 3415.

  Tightening torque: 100 N.m

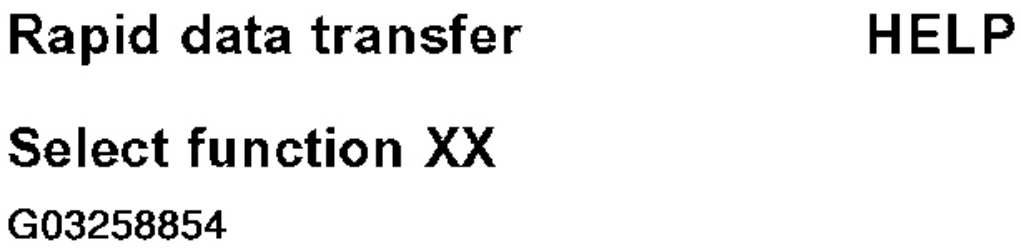


Fig. 121: Installing Camshaft Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: When the camshaft is turned, the crankshaft must not be at TDC. Danger of damage to valves or piston crowns.

The rest of the assembly is basically in reverse order to the disassembly sequence.

Installing toothed belt and adjusting timing. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .

NOTE: When new lifters have been installed the engine must not be started for about 30 minutes. The hydraulic compensation elements must settle (otherwise valves will strike pistons).

Hydraulic lifters, checking

Special tools, equipment, testers, measuring instruments and auxiliary items required

- Feeler gauge
- Wooden or plastic wedge

NOTE:

- **Replace faulty hydraulic lifters complete only (can not be adjusted or serviced).**
- **Irregular valve noises when starting engine are normal.**

Work sequence

- Start engine and run until coolant fan has switched on once.
- Increase engine speed to about 2500 RPM for approx. 2 minutes.

If the hydraulic lifters are still noisy, locate faulty lifters as follows:

- Remove intake manifold upper part. See **INTAKE MANIFOLD UPPER PART, REMOVING AND INSTALLING** .

NOTE: Seal the intake ports in the intake manifold lower section with clean cloths.

- Remove cylinder head cover.
- Rotate crankshaft clockwise, until cam of lifter to be checked is pointing upward.
- Determine clearance between cam lobe and hydraulic lifter.
- If clearance is greater than 0.2 mm, replace hydraulic lifter. If clearance is less than 0.1 mm or no clearance exists, then proceed with check as follows:
- Push hydraulic lifter down lightly with a wooden or plastic wedge. If when hydraulic lifter is pushed down a 0.2 mm thick feeler gauge can be inserted between camshaft and hydraulic lifter, lifter is to be replaced.

Fig. 122: Pushing Hydraulic Lifter
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: When new lifters have been installed the engine must not be started for about 30 minutes. The hydraulic compensation elements must settle (otherwise valves will strike pistons).

Valve guides, checking

Special tools, equipment, testers, measuring instruments and auxiliary items required

- VW 387 Universal dial gauge bracket
- Dial gauge

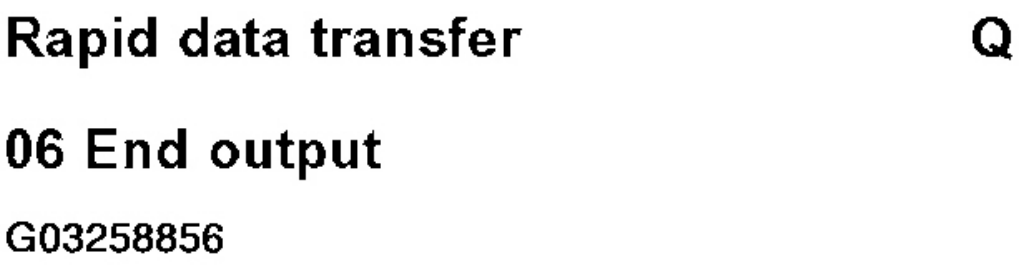


Fig. 123: Identifying Special Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Work sequence

- Insert a new valve into guide. End of valve stem must be flush with guide. Due to slight difference in stem diameters, ensure that only an intake valve is used in intake guide and an exhaust valve in exhaust guide.

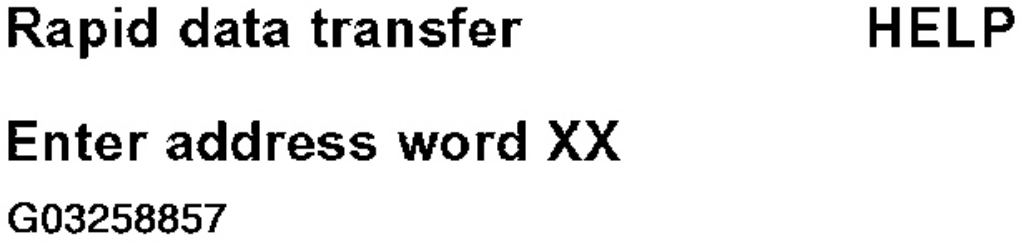


Fig. 124: Checking Valve Guide Wear (Valve Rock)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Determine rock.

  Wear limit:

  Intake valve guide = 1.0 mm

  Exhaust valve guide = 1.3 mm

Valve guides, replacing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 3121 Drift

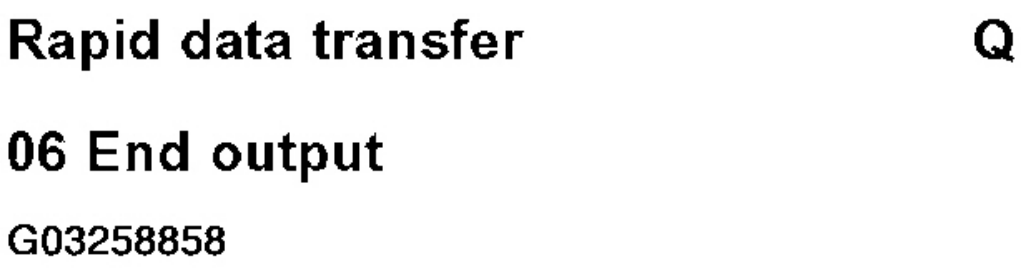


Fig. 125: Identifying 3121 Drift
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- 3120 Reamer and cutting fluid

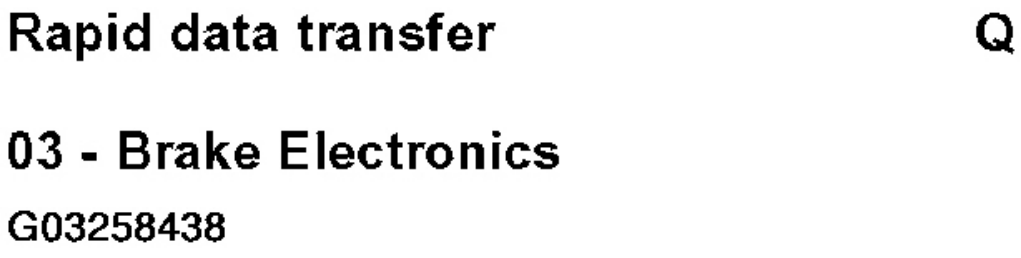


Fig. 126: Identifying 3120 Reamer & Cutting Fluid
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Clean and check cylinder head. Cylinder heads in which valve seats can no longer be reworked. Note minimum dimension. See **VALVE SEATS, REWORKING** . Cylinder heads which have already been machined to minimum dimension, should not have valve guides replaced. See **Fig. 102** .
- Press out worn valve guides with drift 3121 from camshaft side (repair version guides, with a shoulder,

from combustion chamber side).

Installing

- Press in new guides, moistened with oil, from camshaft side onto shoulder in cold cylinder head using drift 3121.

NOTE: When the shoulder on guide makes contact the pressure must not exceed 10kN (approx. 1.0 t) otherwise the shoulder may break off.

- Ream valve guide using hand reamer 3120. Always use cutting fluid when doing this.
- Reworking valve seats. See **VALVE SEATS, REWORKING** .

Valve stem seals, replacing

(with cylinder head installed)

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 2036 Assembly device
- 3047A Puller
- 3122 B Spark plug wrench
- 3129 Installation tool
- T10112 Installation tool
- V.A.G 1331 Torque wrench (5..50 N.m)

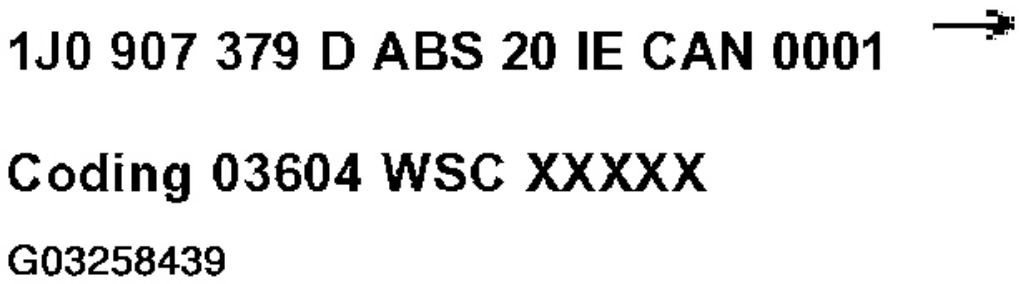


Fig. 127: Identifying Special Tools (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VW 541/1A Lever

- VW 541/5 Press piece
- VW 653/3 Pressure hose

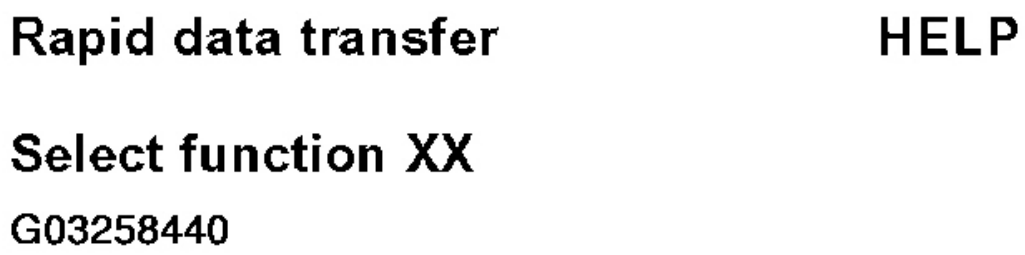


Fig. 128: Identifying Special Tools (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove camshaft. See **CAMSHAFT, REMOVING AND INSTALLING** .
- Take out hydraulic lifter and place down with running surface downward. Ensure hydraulic lifters are not interchanged when doing this.
- Disconnect spark plug connectors with tool T10112
- Remove spark plugs with spark plug wrench 3122B.
- Set piston of appropriate cylinder to "bottom dead centre (BDC)".
- Mount assembly device 2036 and adjust mountings to height of studs.

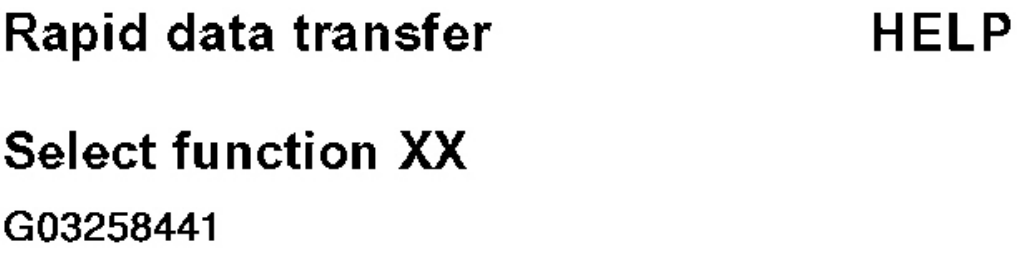


Fig. 129: Mounting Assembly Device 2036, VW 653/3 & VW 541/1A
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Screw pressure hose VW 653/3 into spark plug thread.
- Connect pressure hose to compressed air supply of at least 6 bar.
- Remove valve springs with assembly lever VW 541/1A and thrust piece VW 541/5.

NOTE: Tight keepers can be loosened by tapping lightly on the lever.

- Pull off valve stem seals with 3047A.

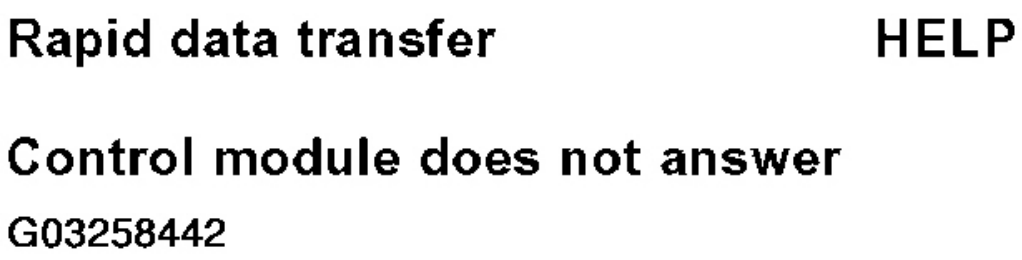


Fig. 130: Removing Valve Stem Seal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

- Place plastic sleeve -A- supplied on appropriate valve stem. This will prevent new valve stem seal -B- being damaged.

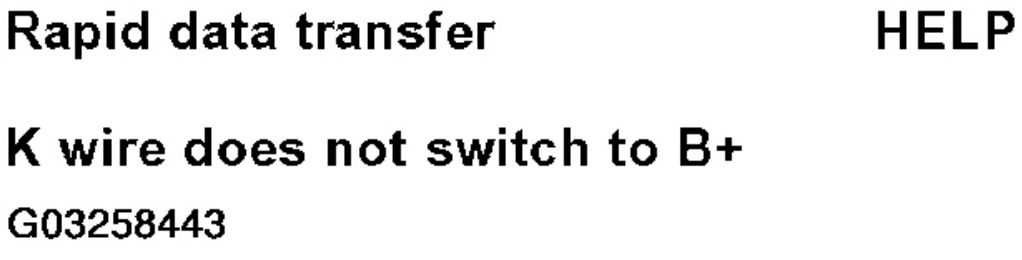


Fig. 131: Installing Valve Stem Seal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Fit new valve stem seal into installation tool 3129.
- Oil valve stem seal sealing lip and press carefully onto valve guide.

ENGINE - LUBRICATION

LUBRICATION SYSTEM

Lubrication system components, removing and installing

NOTE:

- **Metal shavings or large amounts of small metal particles found in the engine oil during repairs may be caused by a partial seizure of the crankshaft or connecting rod bearings. Perform the following work sequences in this situation to prevent consequential damage once repairs are complete:**
  - **Thoroughly clean oil passages**
  - **Replace oil spray jets**
  - **Replace oil cooler**
  - **Replace oil filter**
- **The oil level must not be above the max. mark or there is a danger of damage to catalytic converter. For markings, see Fig. 136 .**

Disassembling and assembling oil filter bracket. See **Part II (Oil filter housing, disassembling and assembling)** .

Engine codes BDC, BGD

Disassembling and assembling oil pump with balancer shaft gear assembly. See **Oil pump with balancer shaft gear assembly, disassembling and assembling (Engine codes BDC, BGD)** .

Removing and installing oil pump with balancer shaft gear assembly. See **OIL PUMP WITH BALANCER SHAFT GEAR ASSEMBLY, REMOVING AND INSTALLING** .

Continuation for all models

Checking oil pressure and oil pressure switch. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING** .

Engine oil specifications

Use engine oils which conform with VW standard 500 00, 501 01 or 502 00. Only in exceptional cases: Multi-grade and single grade oils conforming with API-SF and SG or ACE A A2/A3.

NOTE:

- **In the factory the engine is filled with engine oil conforming with VW standard 503 00. This engine oil is designed for long service intervals**

(ESI).

- **Engine oils conforming to VW standard 500 00, 501 01 or 502 00 may also be used.**

Oil system capacity

See **ENGINE OIL LEVEL, CHECKING** .

Part I (Engine codes AEG, AVH, AZG)

Part II, Disassembling and assembling oil filter housing. See **Part II (Oil filter housing, disassembling and assembling)** .

- For engine codes BDC, BGD, see **Part I (Engine codes BDC, BGD)** .
- For engine code BEV, see **Part I (Engine code BEV)** .

NOTE: The following list refers to items in Fig. 132 .

1. **15 N.m**
2. **Sealing flange**
   - Must be located on dowel sleeves
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING**
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING**
   - Replacing crankshaft oil seal, poly V-belt pulley end. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING**
3. **Pressure relief valve, 27 N.m**
4. **Oil spray jet**
   - For piston cooling
5. **Dipstick**
   - Oil level must not exceed max. mark!
   - Markings. See **Fig. 135**
6. **Dipstick guide**
   - Fastened to intake manifold
   - Pull off to extract oil
7. **Guide tube**
8. **Dowel sleeves**
9. **O-ring**
   - Replace
10. **15 N.m**

11. **Suction line**
    - Observe part number
    - Clean strainer if soiled
12. **Baffle plate**
13. **15 N.m**
14. **Oil sump protection**
    - Not for all engines. See Parts catalog.
    - Assembly overview. See **Fig. 138**
15. **Oil drain plug, 30 N.m**
    - Replace if leaking. See Parts catalog for correct application. In some cases seal and drain plug are combined; do not interchange with separate seal and drain plug.
16. **Oil sump**
    - Clean sealing surface before installing
    - Insert with silicone sealant D 176 404 A2. See **OIL SUMP, REMOVING AND INSTALLING** .
    - Removing and installing. See **OIL SUMP, REMOVING AND INSTALLING** .
17. **Oil pump**
    - With pressure relief valve of 12 bar
    - Before installing, check that both dowel sleeves for centralizing oil pump/cylinder block are installed
    - Replace if running surfaces and gears are scored
    - Removing and installing. See **Oil pump, removing and installing (Engine codes AEG, AVH, AZG, BEV)** .
18. **Chain sprocket**
    - Observe installing position
19. **20 N.m**
    - Use counter support T10051 to loosen and tighten
20. **Chain**
21. **Chain tensioner with tensioning rail, 15 N.m**
    - When installing, pretension spring and fit

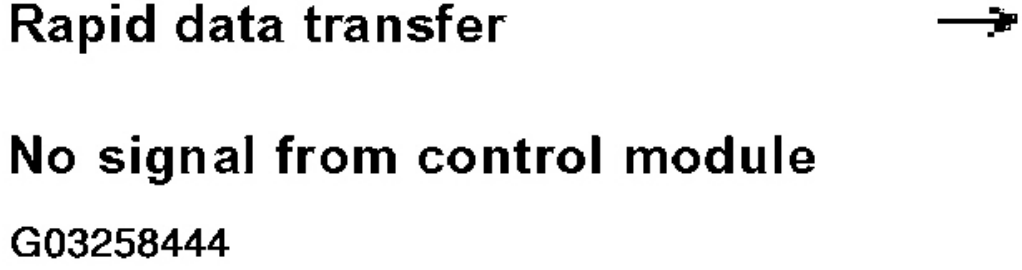


Fig. 132: Exploded View Of Lubrication System Components (Engine Codes AEG, AVH, AZG)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part I (Engine codes BDC, BGD)

- For engine codes AEG, AVH, AZG. See **Part I (Engine codes AEG, AVH, AZG)** .
- For engine code BEV. See **Part I (Engine code BEV)** .

1. **15 N.m**
2. **Sealing flange**
   - Must be seated on dowel sleeves
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
   - Replacing crankshaft oil seal, ribbed belt pulley end. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING** .

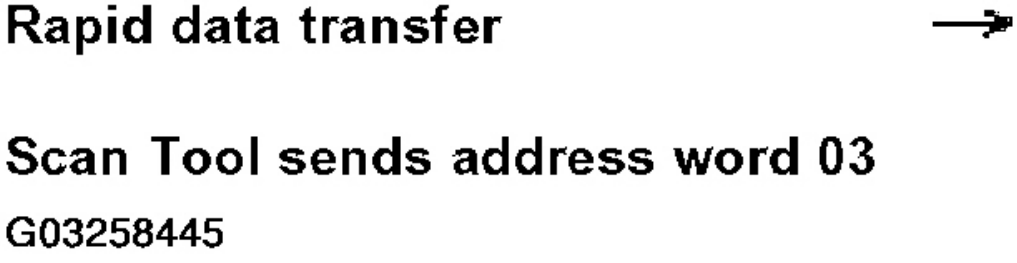


Fig. 133: Exploded View Of Lubrication System Components (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

3. **Cylinder block**
4. **Dipstick**
   - Oil level must not exceed max. mark!
   - Markings. See **Fig. 136**
5. **Dipstick guide**
   - Fastened to intake manifold
   - Pull off to extract oil
6. **Guide tube**
7. **Oil spray jet**
   - For piston cooling
8. **Pressure relief valve, 27 N.m**
9. **Oil pump with balancer shaft gear assembly**
   - With pressure relief valve of 12 bar
   - Removing and installing. See **OIL PUMP WITH BALANCER SHAFT GEAR ASSEMBLY, REMOVING AND INSTALLING** .
   - Disassembling and assembling. See **Oil pump with balancer shaft gear assembly, disassembling and assembling (Engine codes BDC, BGD)** .
10. **15 N.m + 1/4 turn (90°) further**
    - Observe different lengths of bolts. See , **Fig. 137**
11. **15 N.m**
12. **Sump**
    - Clean sealing surface before installing
    - Insert with silicone sealant D 176 404 A2. See **OIL SUMP, REMOVING AND INSTALLING**
    - Removing and installing. See **OIL SUMP, REMOVING AND INSTALLING**
13. **Seal**
    - Replace
    - Cut open seals which have been rolled on
14. **Oil drain plug, 30 N.m**
15. **Chain sprocket**
    - Observe installed position
16. **20 N.m**
17. **Chain guard**
18. **Chain**

Part I (Engine code BEV)

- For engine codes AEG, AVH, AZG. See **Part I (Engine codes AEG, AVH, AZG)**
- For engine codes BDC, BGD. See **Part I (Engine codes BDC, BGD)** .

NOTE: The following list refers to items in Fig. 134 .

1. **15 N.m**
2. **Sealing flange**
   - Must be located on dowel sleeves
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING**
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING**
   - Replacing crankshaft oil seal, poly V-belt pulley end. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING**
3. **Pressure relief valve, 27 N.m**
4. **Oil spray jet**
   - For piston cooling
5. **Dipstick**
   - Oil level must not exceed max. mark!
   - Markings. See **Fig. 135**
6. **Dipstick guide**
   - Fastened to intake manifold
   - Pull off to extract oil
7. **Guide tube**
8. **Dowel sleeves**
9. **O-ring**
   - Replace
10. **15 N.m**
11. **Suction line**
    - Observe part number
    - Clean strainer if soiled
12. **Baffle plate**
13. **Oil sump upper part**
    - Clean sealing surface before installing
    - Insert with silicone sealant D 176 404 A2. See **OIL SUMP, REMOVING AND INSTALLING**
    - Removing and installing. See **OIL SUMP, REMOVING AND INSTALLING**
    - Sell as a set with oil sump lower part protection. For latest oil sump part number:

      See Parts catalog

14. **15 N.m**
15. **22 N.m**
16. **Oil sump lower part protection**
    - Clean sealing surface before installing
    - Insert with silicone sealant D 176 501 A1. See **ENGINE CODE BEV**
17. **Sealing ring**
    - Replace
18. **Oil drain plug, 30 N.m**
    - Replace if leaking. See Parts catalog for correct application. In some cases seal and drain plug are combined; do not interchange with separate seal and drain plug.
19. **10 N.m**
20. **Oil pump**
    - With pressure relief valve of 12 bar
    - Before installing, check that both dowel sleeves for centralizing oil pump/cylinder block are installed
    - Replace if running surfaces and gears are scored
    - Removing and installing. See **Oil pump, removing and installing (Engine codes AEG, AVH, AZG, BEV)**
21. **Chain sprocket**
    - Observe installing position
22. **Chain**
23. **20 N.m**
    - Use counter support T10051 to loosen and tighten
24. **Chain tensioner with tensioning rail, 15 N.m**
    - When installing, pretension spring and fit

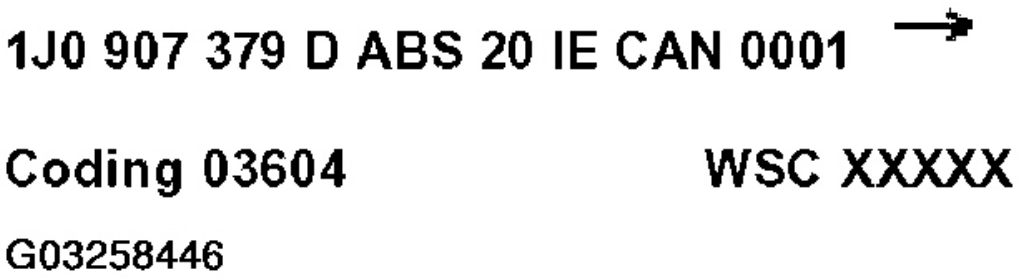


Fig. 134: Exploded View Of Lubrication System Components (Engine Code BEV)

Courtesy of VOLKSWAGEN OF AMERICA, INC.

Dipstick Marks (Engine codes AEG, AVH, AZG, BEV)

NOTE: The following list refers to items in Fig. 135 .

1. max. mark
2. min. mark
    a. Area above hatched field up to max. mark: Do not add engine oil!
    b. Oil level within hatched field: Engine oil may be added
    c. Area from min. mark up to hatched field: Add max. 0.5L. of engine oil!

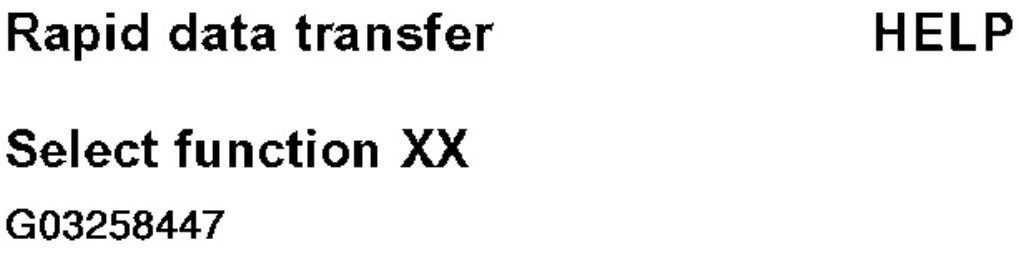


Fig. 135: Identifying Dipstick Marks (Engine Codes AEG, AVH, AZG, BEV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

(Dipstick Marks) Engine codes BDC, BGD

NOTE: The following list refers to items in Fig. 136 .

1. max. mark
2. Min. mark
    a. Area above hatched field up to max. mark: Do not add engine oil!
    b. Oil level within hatched field: Engine oil may be added
    c. Area from min. mark up to hatched field: Add max. 0.5L. of engine oil!

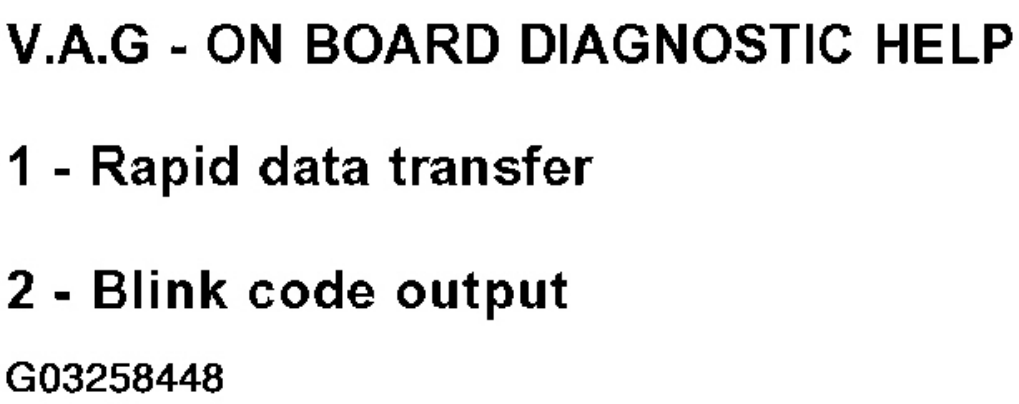


Fig. 136: Identifying Dipstick Marks (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Bolt allocation for balancer shaft gear assembly (Engine codes BDC, BGD)

A. M7 x 40 hex bolt
B. M7 x 55 hex bolt
C. M7 x 90 hex bolt
D. Sealing plug with O-ring

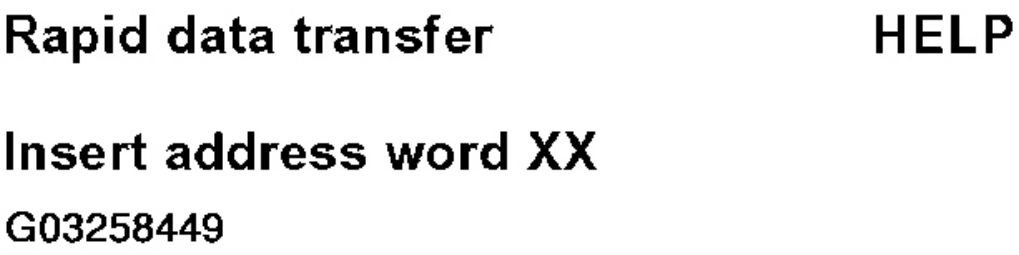


Fig. 137: Identifying Bolt Allocation For Balancer Shaft Gear Assembly (Engine codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 138 .

1. Rubber grommet
    - located in cylinder block
2. Spreader rivet
3. Spreader rivet
    - to remove oil sump protection push upward
    - to install press in flush
4. Socket
5. Bolt, 37 N.m
    - secure in cylinder block
    - clean threads before installing
    - install with locking compound D 000 600 A2
6. Oil sump protection

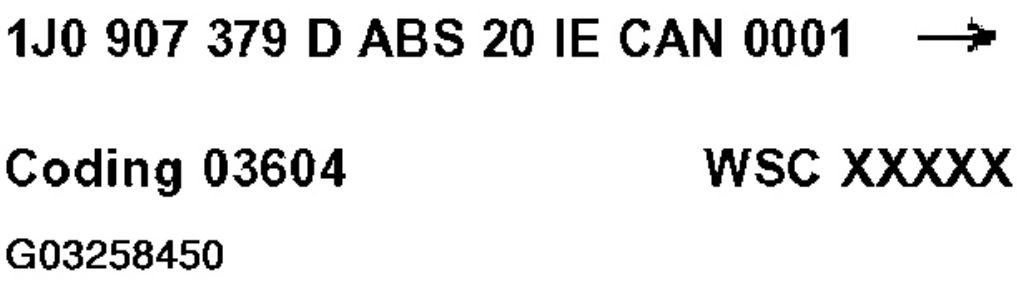


Fig. 138: Exploded View Of Oil Sump Protection Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part II (Oil filter housing, disassembling and assembling)

NOTE: The following list refers to items in Fig. 139 .

1. **Sealing plug, 40 N.m**
    - Replace
2. **Seal**
    - Installed firmly on item -1-
3. **Spring**
    - For pressure relief valve, approx. 4 bar
4. **Piston**
    - For pressure relief valve, approx. 4 bar

5. **Seal**
    - Replace
6. **Non-return valve, 8 N.m**
    - Various versions: bolted or pressed
    - Press fit valves are not available as spare parts
7. **Seal**
    - Slide on up to shoulder of sealing cover item - 8 -
    - Replace if damaged
8. **Cover**
9. **Retaining clip**
10. **Sealing plug, 15 N.m**
11. **Seal**
    - If sealing ring is leaking cut open and replace.
12. **1.4 bar oil pressure switch -F1-, 25 N.m**
    - Black
    - Checking. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING**
13. **Seal**
    - If sealing ring is leaking cut open and replace.
14. **Oil filter bracket**
    - With pressed in non-return valve
15. **15 N.m + 1/4 turn (90°) further**
    - Replace
16. **Seal**
    - Replace
    - Clip into lugs on oil cooler
17. **Oil cooler**
    - Coat contact surfaces to oil filter bracket outside seal with AMV 188 100 02
    - Ensure clearance to adjacent components
    - See note. See **LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING** .
18. **25 N.m**
19. **Oil filter**
    - Loosen with filter strap or oil filter key 3417
    - Tighten by hand
    - Note instructions on filter when installing

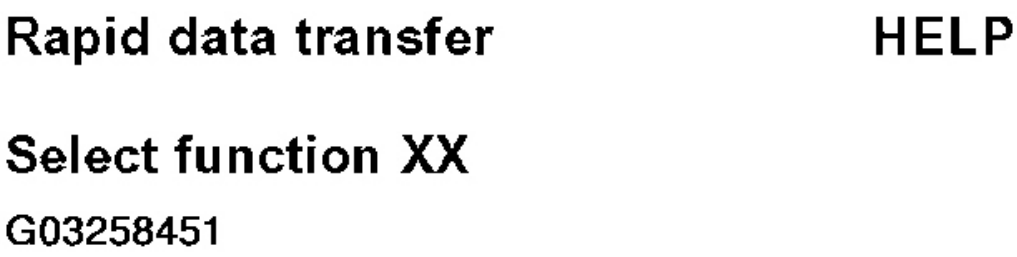


Fig. 139: Exploded View Of Oil Filter Housing
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Oil pump, removing and installing (Engine codes AEG, AVH, AZG, BEV)

Removing

- Remove sump and baffle plate. See **OIL SUMP, REMOVING AND INSTALLING** .
- Unscrew bolt -2-.
- Pull off chain sprocket from oil pump shaft.
- Unscrew bolts -1- and -3- and remove oil pump.

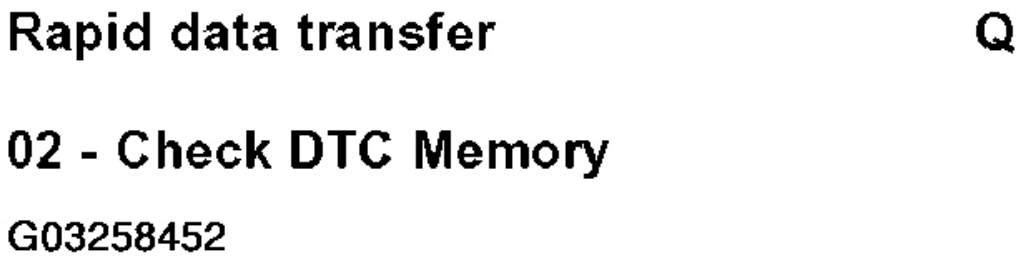


Fig. 140: Removing And Installing Oil Pump (Engine codes AEG, AVH, AZG, BEV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

Install in reverse order. Note the following:

Dowel sleeves. See **Fig. 132** , item 8 above oil pump.

- Installed position of oil pump shaft/chain sprocket: Can only be installed in one position.

Installing sump and baffle plate. See **OIL SUMP, REMOVING AND INSTALLING**

Tightening torques. See **Part I (Engine codes AEG, AVH, AZG)**

Oil pump with balancer shaft gear assembly, disassembling and assembling (Engine codes BDC, BGD)

NOTE: The following list refers to items in Fig. 141 .

1. **Chain guard**
2. **Chain**
   - Mark direction of rotation before removing (installation position)
3. **Dowel sleeves**
4. **Oil pump with balancer shaft gear assembly**
   - Before installing, check that both dowel sleeves for centralizing are installed
5. **3 N.m**
   - Insert with locking compound D 000 600 A2
6. **Cover**
   - Prevents engine oil foaming
7. **Oil return union**
   - With seal/gasket
8. **9 N.m**
9. **Suction line**
   - Clean strainer if soiled
10. **8 N.m**
11. **O-ring**
    - Replace
12. **15 N.m + 1/4 turn (90°) further**
    - Observe different lengths of bolts. See **Fig. 137**
13. **O-ring**
    - Replace
14. **Sealing plug, 15 N.m + 1/4 turn (90°) further**
15. **Dowel sleeves**
16. **Outer rotor**
    - Check running surfaces for scoring
    - Marking(s) must be visible

17. **Inner rotor**
    - Check running surfaces for scoring
18. **Oil pump cover**
19. **8 N.m**
20. **Chain sprocket**
21. **20 N.m**
22. **Chain tensioner with tensioning plate**
    - Pre-tension when installing. See **PRE-TENSIONING CHAIN TENSIONER**
23. **15 N.m**

Fig. 141: Exploded View Of Oil Pump With Balancer Shaft Gear Assembly (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Pre-tensioning chain tensioner

- Tension piston by hand (arrow).

Fig. 142: Tensioning Piston (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press chain rail in direction of arrow and lock with a 3 mm Allen key -1-.

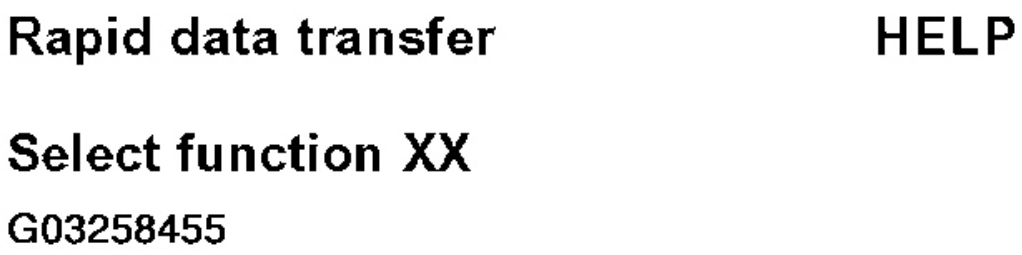


Fig. 143: Pressing Chain Rail (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

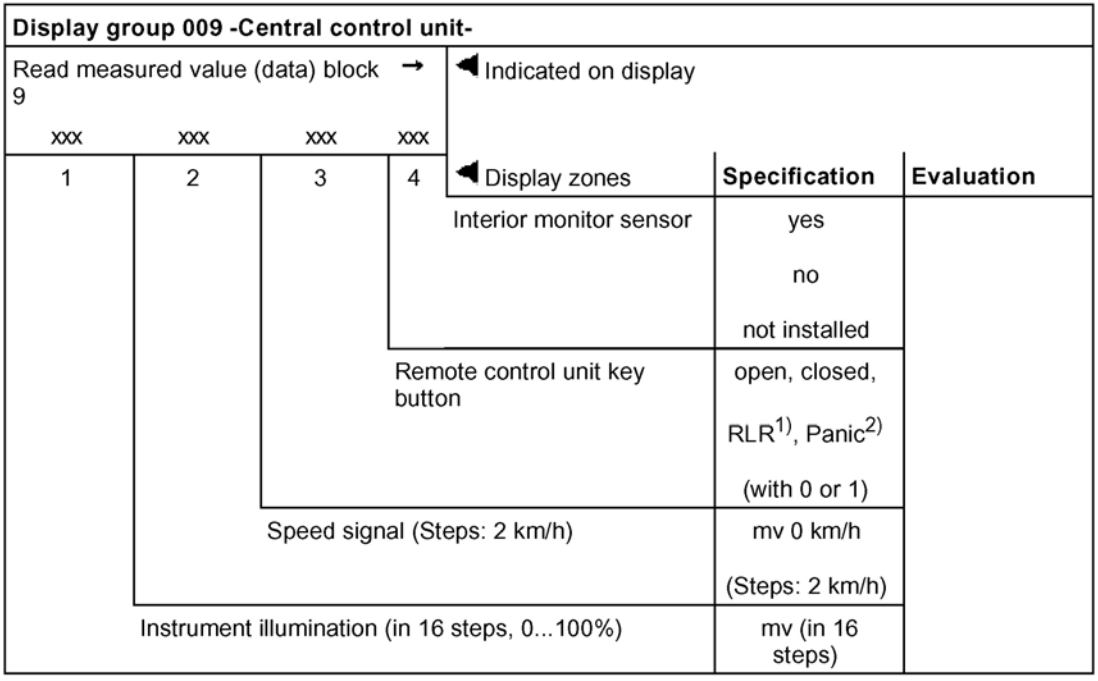
Oil pump with balancer shaft gear assembly, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- T10060 Locking pin

Removing

- Remove oil sump. See **OIL SUMP, REMOVING AND INSTALLING** .



Display group 009 -Central control unit-						
Read measured value (data) block 9 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Interior monitor sensor	yes no not installed	
				Remote control unit key button	open, closed, RLR[1], Panic[2] (with 0 or 1)	
				Speed signal (Steps: 2 km/h)	mv 0 km/h (Steps: 2 km/h)	
				Instrument illumination (in 16 steps, 0...100%)	mv (in 16 steps)	

[1] RLR= Rear Lid Remote Release

[2] Only vehicles for USA, alarm system and turn signal lights are activated

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Fig. 144: Identifying Special Tool T10060
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pull chain guard off. Release locking lugs by inserting a small screwdriver through openings (arrows) if necessary.

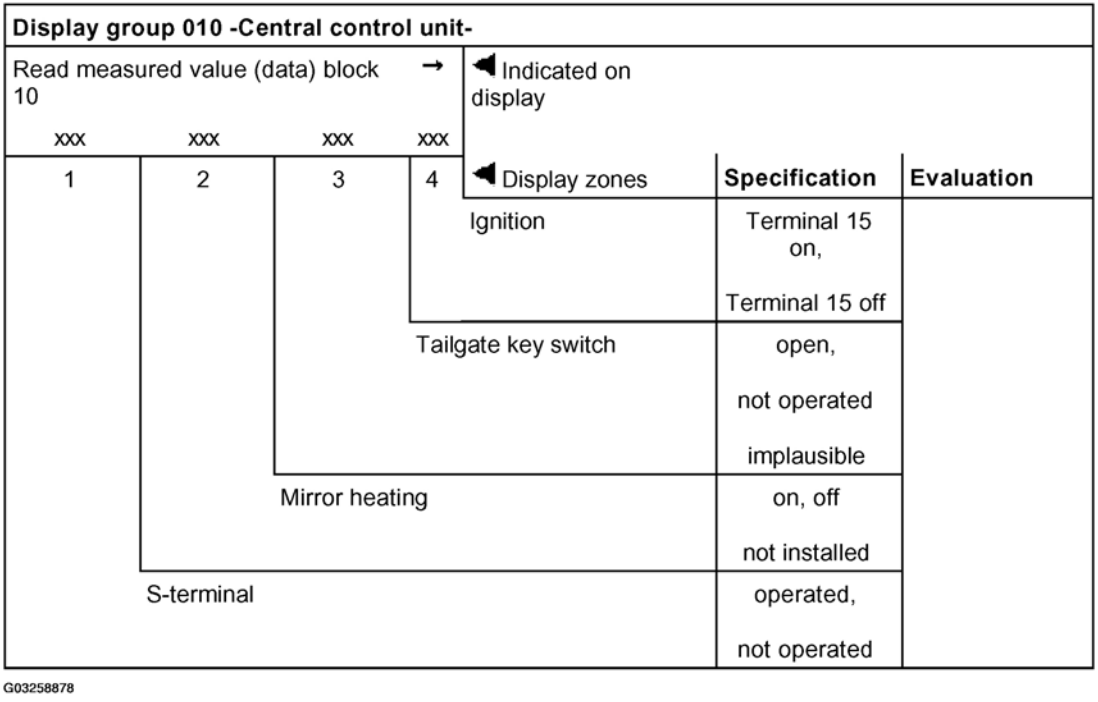

Fig. 145: Removing Chain Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen bolt on oil pump chain sprocket.

Display group 011 -Central control unit-						
Read measured value (data) block 11 →				◄ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◄ Display zones	**Specification**	**Evaluation**
				Empty[1)]		
				Sliding/tilting sunroof released[2)]	yes, no	
				Trunk lid/tailgate contact switch	open, closed	
				Hood contact switch	operated, not operated, not installed	

[1)] Empty means in this case: Display zone is blank

[2)] The central control unit transmits a switch-off delayed terminal 15 to the sliding roof control unit. The sliding/tilting roof can then still be operated from the point when the ignition is switched off until one of the front doors is opened.

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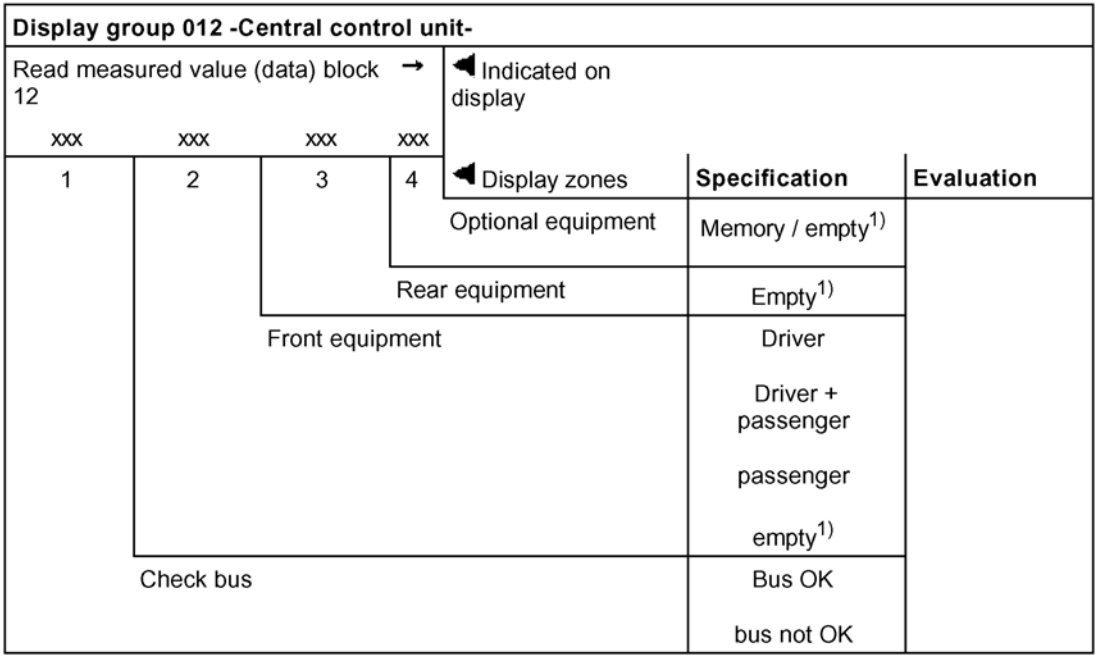
Fig. 146: Loosening Bolt On Oil Pump Chain Sprocket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Relieve tension on chain rail using a screwdriver (arrow) and lock rail using a 3 mm Allen key -1-.



Display group 012 -Central control unit-						
Read measured value (data) block 12 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Optional equipment	Memory / empty[1)]	
				Rear equipment	Empty[1)]	
				Front equipment	Driver	
					Driver + passenger	
					passenger	
					empty[1)]	
		Check bus			Bus OK	
					bus not OK	

[1)] Empty means in this case: Display zone is blank

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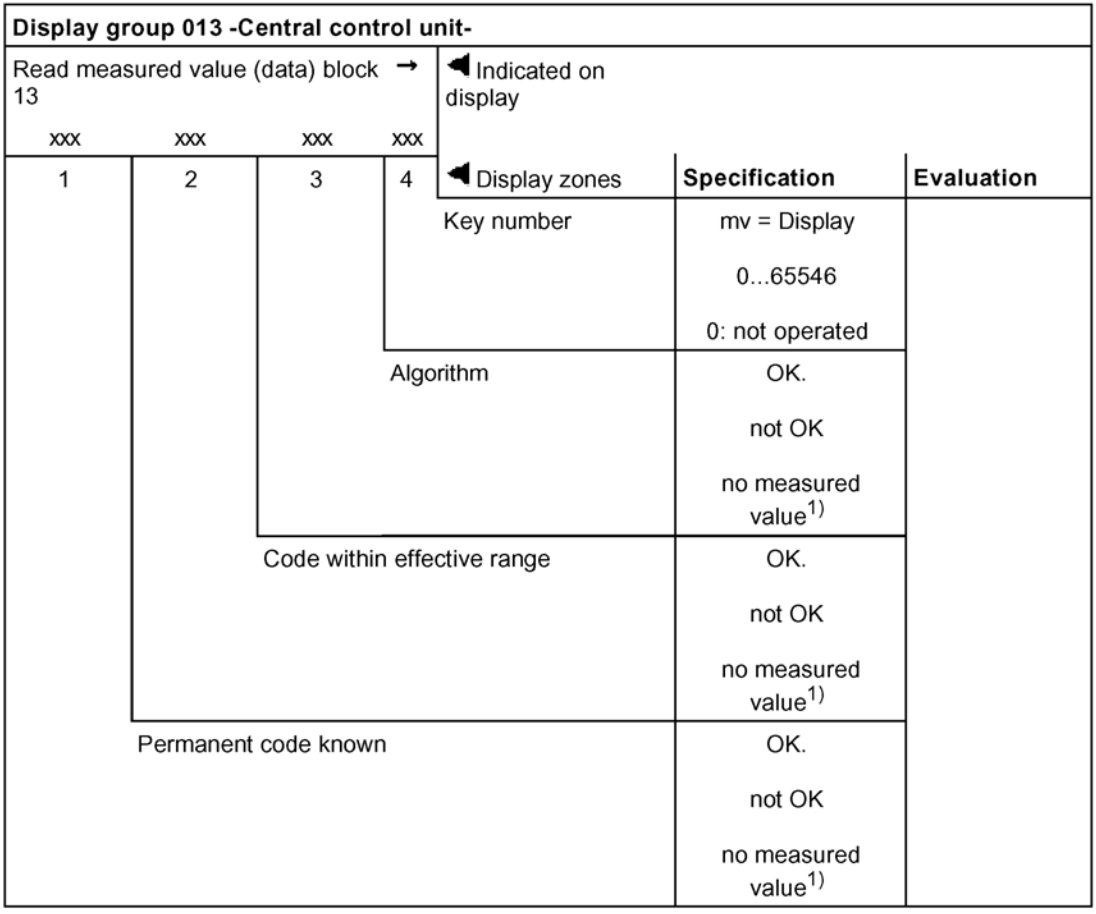
Fig. 147: Relieving Tension On Chain Rail
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove oil pump chain sprocket and take chain off balancer shaft gear assembly.



Display group 013 -Central control unit-						
Read measured value (data) block → 13				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Key number	mv = Display 0...65546 0: not operated	
				Algorithm	OK. not OK no measured value[1)]	
				Code within effective range	OK. not OK no measured value[1)]	
				Permanent code known	OK. not OK no measured value[1)]	

[1)] If the remote control key is operated several times the third display - no measured value - will change to "OK".

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Fig. 148: Removing Chain From Balancer Shaft Gear Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen securing bolts on balancer shaft gear assembly (starting at outer sides and working inward) and remove them. Disassembling and assembling oil pump with balancer shaft gear assembly. See **Oil pump with balancer shaft gear assembly, disassembling and assembling (Engine codes BDC, BGD)** .

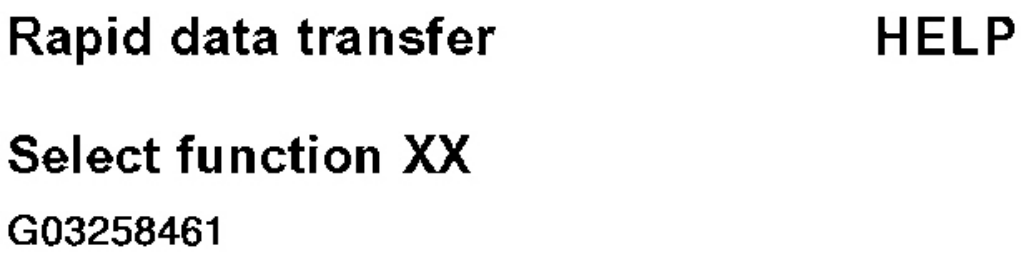

Fig. 149: Loosening Securing Bolts On Oil Pump Balancer Shaft Gear Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing and adjusting oil pump with balancer shaft gear assembly

Requirements

- Chain tensioner pre-tensioned. See **PRE-TENSIONING CHAIN TENSIONER**
- Install oil pump with balancer shaft gear assembly. Tighten securing bolts (starting on inside and working outward) to 15 N.m + 1/4 turn (90°) further.

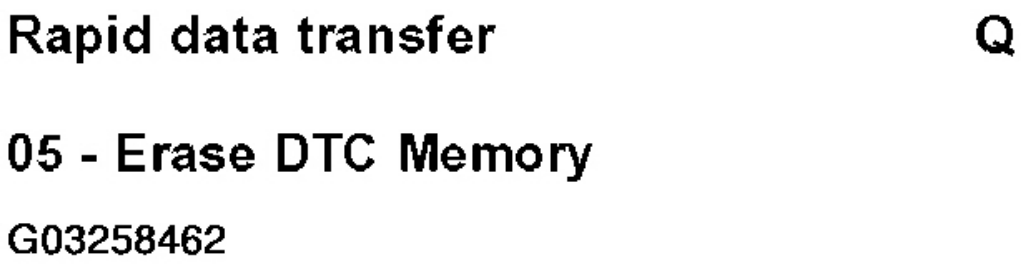

Fig. 150: Locating Oil Pump With Balancer Shaft Gear Assembly Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Observe different lengths of bolts. See Fig. 137 .

- Set crankshaft to TDC No. 1 cylinder.

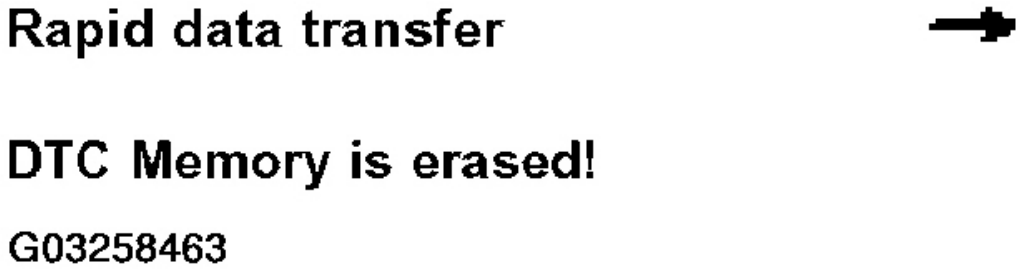

Fig. 151: Locating Marks For Setting Crankshaft To TDC No. 1 Cylinder
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Align mark on balancer shaft chain sprocket (arrow) with fixture hole. Lock chain sprocket in this position with pin T10060. Fit chain onto balancer shaft chain sprocket.

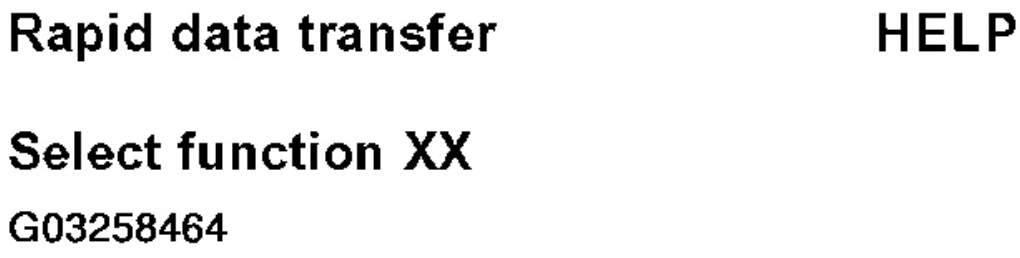

Fig. 152: Aligning Mark On Balancer Shaft Chain Sprocket With Fixture Hole
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Position milled side of oil pump shaft so that it is facing forward.
- Install oil pump chain sprocket and tighten bolt hand tight.

NOTE: The oil pump chain sprocket only fits in one position. Only the oil pump may be turned when installing.

- Remove locking pin T10060 and Allen key -1-. Secure oil pump chain sprocket.

Fig. 153: Removing Locking Pin And Allen Key
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Tightening torque: 20 N.m. Counter support on central bolt of vibration damper.

The rest of the assembly is basically in reverse order to the disassembly sequence.

Oil sump, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 3185 Jointed wrench
- T10058 Socket
- V.A.G1331 Torque wrench (5...50 N.m)
- Hand drill with plastic brush attachment
- Silicone sealing compound D 176 404 A2

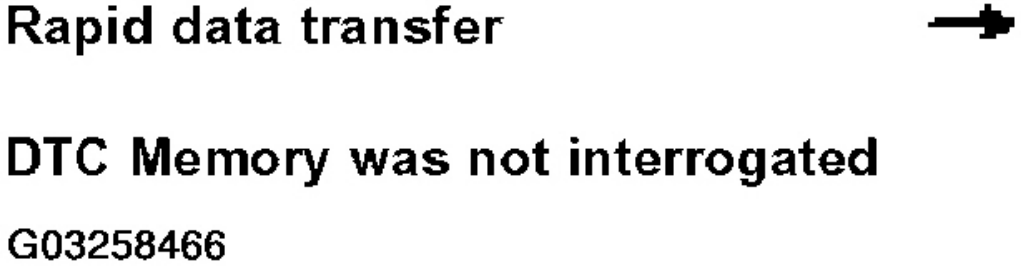

Fig. 154: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

NOTE: For engine code BEV, the oil sump is composed of two parts (upper and lower). The oil sump can be dismounted complete from its union to the engine block. If it is necessary, the upper part may be separated from the lower part. See Part I (Engine code BEV) .

- Remove center and right insulation trays:

  See **NOISE INSULATION, ASSEMBLY OVERVIEW** .

Engines with oil sump protection

1. Rubber grommet
   - located in cylinder block
2. Bolt, 37 N.m
3. Spreader rivet
4. Oil sump protection
   - To remove spreader rivet -3- push upward. See **Fig. 138**
   - Have a second technician push oil sump protection -4- against oil sump.

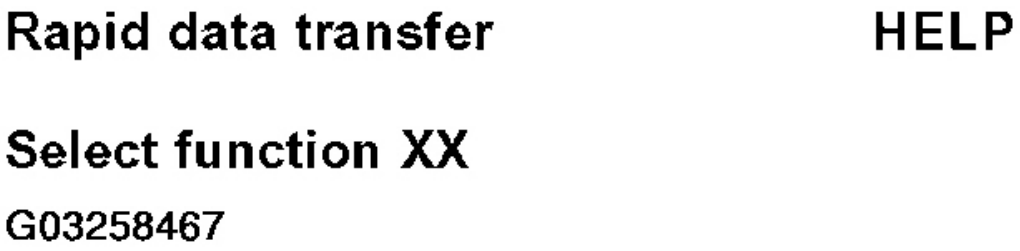

Fig. 155: Removing Oil Sump Protection
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen bolts -2-.
- Carefully remove oil sump protection -4-

Continuation for all models

- Drain engine oil.

NOTE: Observe waste disposal regulations!

- Use jointed wrench 3185 when loosening and tightening sump bolts. Only loosen and tighten bolts on flywheel end using socket T10058
- Remove sump cover and remove sump. It may be necessary to release sump by applying light blows with a rubber headed hammer.
- Remove sealant residue from cylinder block with a flat scraper.
- Remove sealant residue from oil sump with a rotating brush, e.g. a hand drill with a plastic brush attachment (wear eye protection).

Fig. 156: Removing Sealant Residue From Oil Sump With A Rotating Brush
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Clean sealing surfaces. Surfaces must be free of oil and grease.

Installing

NOTE:

- **Note the use-by date of the sealant.**
- **The sump must be installed within 5 minutes of applying silicone sealing compound.**

- Cut off tube nozzle at front marking (nozzle approx. 3 mm diameter).

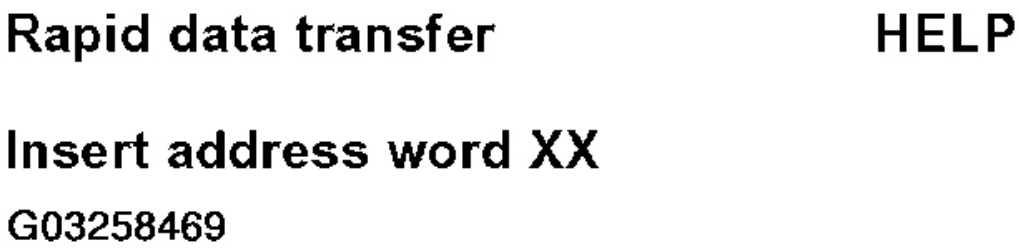

Fig. 157: Applying Silicone Sealing Compound To Sump Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Apply silicone sealing compound, as shown, to clean sump sealing surface. Sealing compound bead must be:
  - 2...3 mm thick (for engine code BEV: 1...2 mm thick)
  - and run on inside of bolt holes (arrows).

NOTE: **The sealing compound bead must not be thicker, otherwise excess sealing compound will enter the sump and may block the oil suction pipe strainer.**

NOTE:

- **When installing the sump on an engine which is removed from the vehicle, ensure that the sump is flush with the cylinder block on the flywheel end.**
- **The sealant must be allowed to cure for approx. 30 minutes after installing the sump. After this time the engine may be filled with engine oil.**

- Carefully apply sealing compound bead in areas marked by arrows. (illustration shows position of sealant bead on cylinder block).

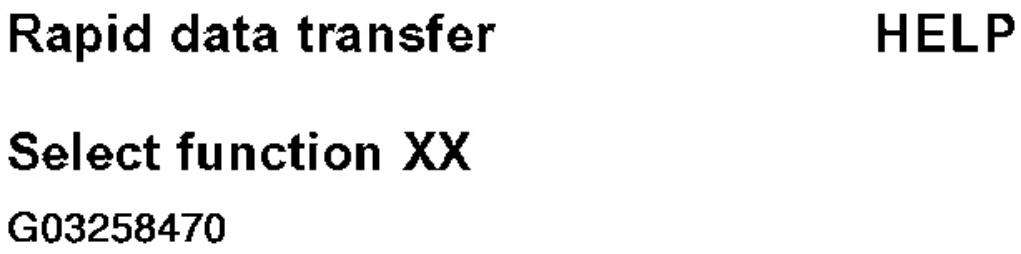

Fig. 158: Locating Areas For Applying Sealing Compound Bead
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install sump immediately and tighten bolts as follows:

1. Tighten all sump/cylinder block bolts lightly using diagonal sequence.
2. Tighten three sump/transmission bolts lightly.
3. Tighten all sump/cylinder block bolts lightly using diagonal sequence again.
4. Tighten sump/transmission bolts to 45 N.m.
5. Tighten all sump/cylinder block bolts to 15 N.m using diagonal sequence.

Engine code BEV (Oil sump lower part protection)

NOTE:

- **Note the use-by date of the sealant.**
- **The sump must be installed within 5 minutes of applying silicone sealing compound.**

- Apply silicone sealing compound D 176 501 A1, as shown, to clean sump sealing surface.

Rapid data transfer HELP

07 - Code Control Module

G03258471

Fig. 159: Locating Areas For Applying Silicone Sealing Compound (Engine Code BEV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Sealing compound bead must be A = 1...2 mm. thick.
- and run on inside of bolt holes (arrows).

NOTE:

- **The sealing compound bead must not be thicker, otherwise excess sealing compound will enter the sump and may block the oil suction pipe strainer.**
- **When installing the sump on an engine which is removed from the vehicle, ensure that the sump is flush with cylinder block on the flywheel end.**
- **The sealant must be allowed to cure for approx. 30 minutes after installing the sump. After this time the engine may be filled with engine oil.**

NOTE: Models with oil sump protection

- **Check condition of the rubber grommets located in the cylinder block for spreader rivets, before installing the oil sump protection.**
- **Before tightening bolts, clean the threads and apply D 000 600 A2.**

- Install spreader rivets -3- in oil sump protection -4-. See **Fig. 138**

Code Control Module

Enter code number XXXXX (03604)

G03258472

Fig. 160: Installing Oil Sump Protection
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten bolts -2- to 37 N.m.

Continuation for all models

The rest of the assembly is basically in reverse order to the disassembly sequence.

Oil pressure and oil pressure switch, checking

Special tools, equipment, testers, measuring instruments and auxiliary items required

- V.A.G 1342 Oil pressure tester
- V.A.G 1527 B Diode test lamp
- V.A.G 1594 A Adapter set

1J0 907 379 D ABS 20 IE CAN 0001 →

Coding 03504 WSC XXXXX

G03258473

Fig. 161: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Function of dynamic oil pressure warning system

The oil pressure switch is open at no pressure and closes when the switch pressure is reached.

The oil pressure is activated approx. 10 seconds after switching the ignition on ("terminal 15 on").

Switch-on delay for oil pressure warning: approx. 3 seconds

Switch-off delay for oil pressure warning: approx. 5 seconds

Checking warning lamp

After switching on the ignition when the engine is not running, the oil pressure warning lamp in the instrument cluster must light up for approx. 3 seconds and go out again. The check is terminated if the engine is running.

Criteria for warning

The optical oil pressure warning switches on (the oil pressure warning lamp flashes) and the buzzer sounds three times for audible warning under one of the following conditions.

- "Ignition on", engine at rest, oil pressure switch closed
- Engine speed higher than 1500 RPM, oil pressure switch open

At an engine speed greater than 5000 RPM the oil pressure warning is not erased; even when the oil pressure switch is closed. Oil pressure warning goes out below 5000 RPM.

If the oil pressure switch is open (engine revs greater than 1500) for 0.5... 3 seconds, this is stored in the processor of the instrument cluster. If this condition happens three times while the engine is running, the oil pressure warning is immediately triggered and remains on, even below 1500 RPM. The oil pressure warning goes out when the oil pressure switch is closed for longer than 5 seconds when engine revolutions are greater than 1500 RPM or the ignition is switched off.

Requirements

- Engine oil level OK, checking. See **Dipstick Marks (Engine codes AEG, AVH, AZG, BEV)**
- Oil pressure warning light -K3- must light up for approx. 3 seconds when ignition is switched on
- Engine oil temperature at least 80 °C (coolant fan must have run once)

NOTE: Functional check and servicing the optical and acoustic oil pressure warning:
See Electrical Wiring Diagrams, Troubleshooting & Component Locations

Work sequence

- Remove Oil pressure switch -F1- and screw into tester.

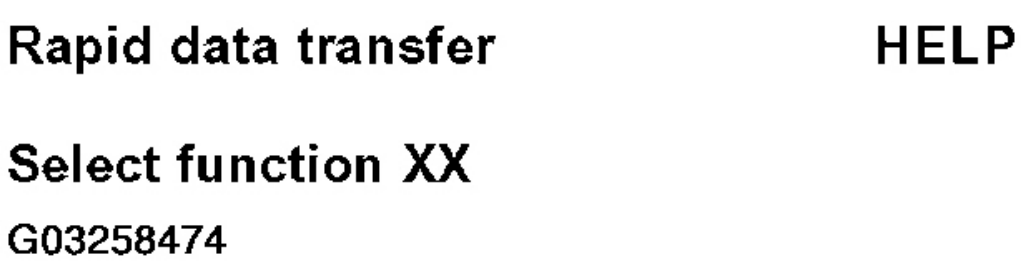

Fig. 162: Checking Oil Pressure And Oil Pressure Switch
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Screw tester into oil filter bracket in place of oil pressure switch.
- Connect brown wire of tester to Ground (-).
- Connect diode test lamp V.A.G 1527 B using auxiliary cables from V.A.G 1594 A to battery positive (+) and oil pressure switch.

  LED must not light up

If the LED lights up:

- Replace 1.4 bar Oil pressure switch -F1-.

If the LED does not light up:

- Start engine and increase revolutions slowly.

  At 1.2...1.6 bar LED must light up

If the LED does not light up:

- Replace oil pressure switch.
- Increase engine speed further.

  At 2000 RPM and an oil temperature of 80 °C oil pressure should be between 2.7... 4.5 bar

  At higher engine speeds the oil pressure must not exceed 7.0 bar

If the specifications are not attained:

- Correct mechanical damage, e.g. bearing damage.
- Check O-ring of sealing plug for damage. See **PRE-TENSIONING CHAIN TENSIONER** , item - 13 -.
- Replace oil filter bracket with pressure relief valve. See **Fig. 139** , item -14 - or (for engine code BDC, BGD) oil pump with balancer shaft gear assembly.

If no failure was found:

- Replace engine pump

If the specification is exceeded:

- Check oil galleries.
- If necessary, replace oil filter bracket with pressure relief valve. See **Fig. 139** , item -14-.

GENERAL, TECHNICAL DATA

TECHNICAL DATA

Engine number

The engine number ("Code letters" and "Serial number") can be found on the front at the connection between the engine and transmission.

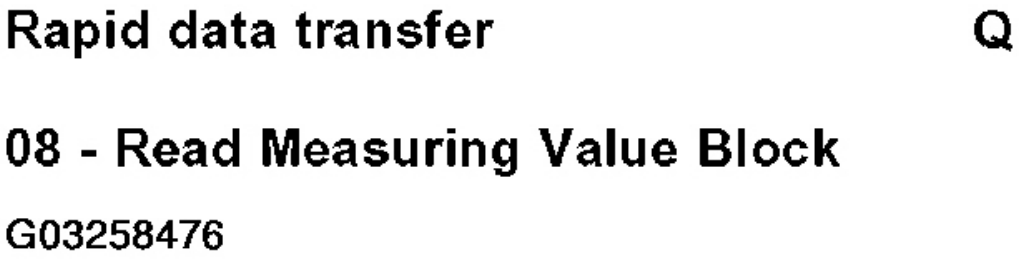

Fig. 1: Identifying Engine Number Location
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Additionally there is a sticker on the cylinder head cover with "Engine code" and "Serial number."

The engine code is also included on the vehicle data plate.

Engine data

ENGINE DATA

Engine code	APH	AWV	AWP
Manufactured starting	02.99 and up	07.00 and up	09.01 and up
Exhaust gas limits according to	OBD II	OBD II	OBD II
Displacement l	1.8	1.8	1.8
Output kW @ RPM	110/5800	110/5700	132/5500
Torque N.m @ RPM	220 @ 2000 to 4200	220 @ 1750 to 4600	235 @ 1950 to 5000
Bore diameter mm	81.0	81.0	81.0
Stroke mm	86.4	86.4	86.4

Compression ratio	9.5:1	9.5:1	9.5:1
RON min.	95 unleaded	95 unleaded	98 unleaded
System identification	Motronic ME7.5	Motronic ME7.5	Motronic ME7.5
Emissions limits according to	TLEV(1)	LEV(2)	LEV(2)
Knock sensor control	2 knock sensors	2 knock sensors	2 knock sensors
On Board Diagnostic (OBD)	OBD II	OBD II	OBD II
Oxygen sensor control	2 sensors	2 sensors	2 sensors
Three Way Catalytic Converter (TWC)	yes	yes	yes
Exhaust Gas Recirculation (EGR)	no	no	no
Variable intake manifold	no	no	no
Camshaft adjustment	no	yes	yes
Turbocharging system	yes	yes	yes
Boost pressure regulation	yes	yes	yes
Secondary air system	yes	yes	yes

(1) TLEV = Transitional Low Emission Vehicles (emission values max. 0.125 g/mi HC)

(2) LEV = Low Emission Vehicles (emission values max. 0.075 g/mi HC)

ENGINE - ASSEMBLY

ENGINE, REMOVING AND INSTALLING

Special tools and equipment

- VW 313 Support clamp
- VW 540 Engine and transmission support
- 2024 A Lifting tackle
- 3180 Retainer (for turbocharged engines)
- VAG1202 A Workshop crane
- VAG1306 Drip tray

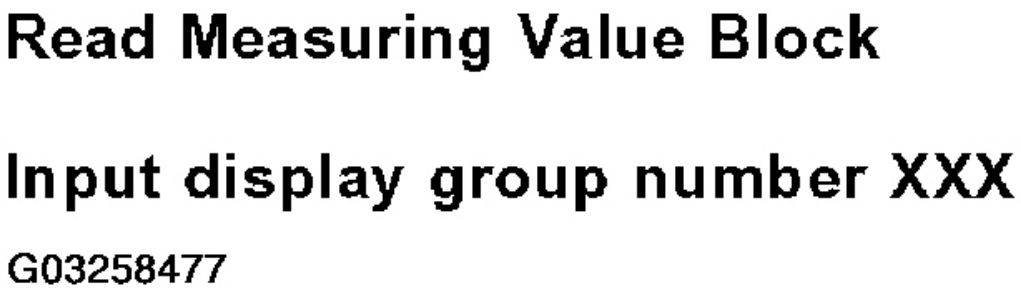

Fig. 2: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG1331 Torque wrench (5-50 N.m)
- VAG1332 Torque wrench (40-200 N.m)
- VAG1383 A Engine/transmission jack
- T10012 Engine bracket
- VAS 5024 Assembly tool for spring-type clamps
- V.A.S 5085 Step ladder (not shown)
- G 000 100 grease (vehicles with manual transmission) (not shown)
- Bolt M1 0X 25 / 8.8 (not shown)
- Cable tie (not shown)

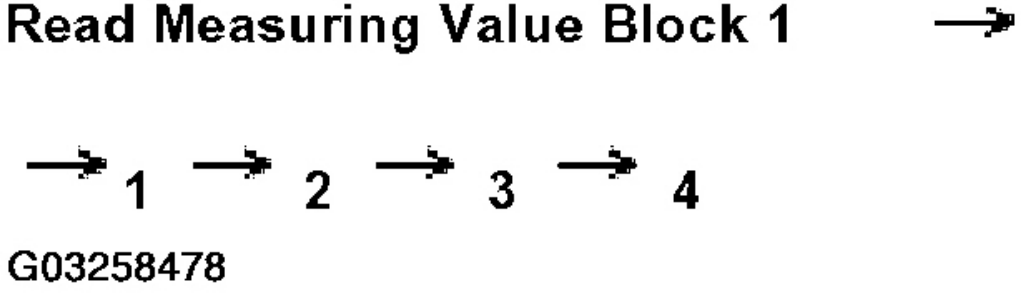

Fig. 3: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removal notes

- First check whether a coded radio is installed. If so, obtain anti-theft coding.

The engine is removed downward together with the transmission.

- With ignition switched off, disconnect battery Ground strap.
- All cable ties which are opened or cut open when removing engine must be replaced in same position when installing engine.
- Remove engine cover.
- Remove air cleaner:

  See **AIR FILTER, DISASSEMBLING AND ASSEMBLING** .

- Remove intake hose between Mass Air Flow (MAF) sensor -G70- and turbocharger.

  See **FUEL INJECTION, SERVICING** .

- Remove power steering fluid reservoir from battery holder without disconnecting hoses.
- Fasten reservoir to lock carrier.
- Remove battery and battery retainer.
- Pull vacuum and breather hoses off engine.

WARNING:

- **Fire Hazard! Do NOT have anything in the area that can ignite fuel!**
- **Fuel supply lines are under pressure! Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.**

- Pull off supply line/hose -1- (with white marking) and return line/hose -2- (with blue marking) and collect fuel that leaks out with a cloth.

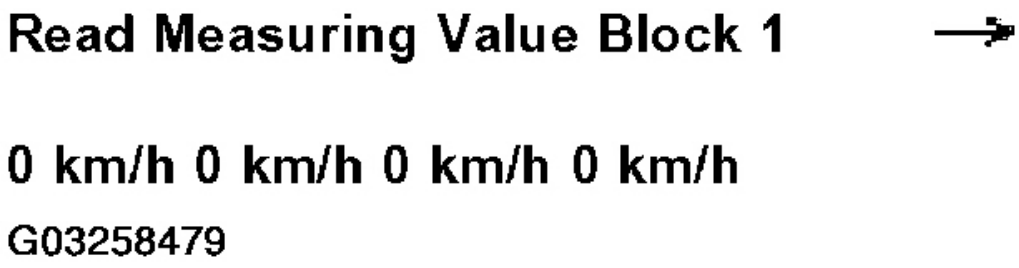

Fig. 4: Pulling Off Supply Line/Hose And Return Line/Hose
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Seal pipes so that fuel system is not contaminated by dirt etc.
- Pull hose off solenoid valve.

NOTE: Press buttons on hose couplings to do this.

- Loosen and remove intake hose (between charge air cooler and Throttle Valve Control Module -J338-) at Throttle Valve Control Module -J338-.
- Disconnect harness connector for Intake Air Temperature (IAT) sensor -G42-, -1- and -4- for Throttle Valve Control Module -J338- below Throttle Valve Control Module -J338-.

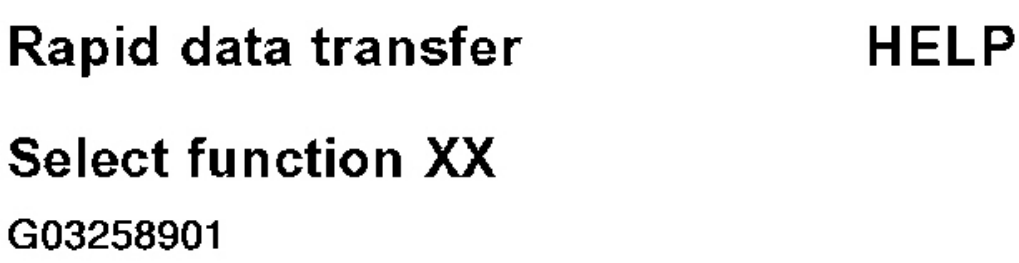

Fig. 5: Disconnecting Harness Connector For Intake Air Temperature Sensor G42
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pull connector off Camshaft Position (CMP) sensor -G40- -arrow-.

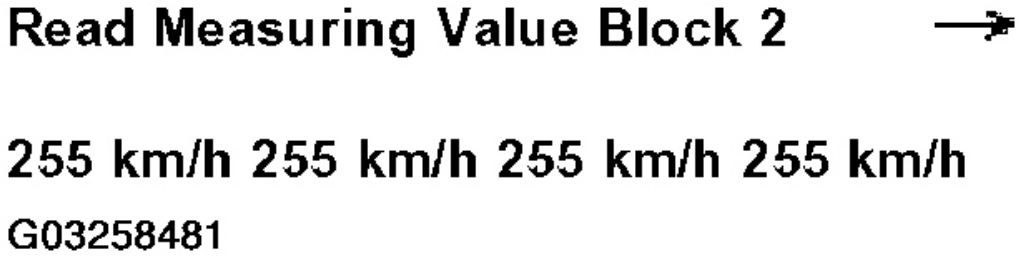

Fig. 6: Pulling Connector Off Camshaft Position Sensor G40
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unbolt vacuum canister from cylinder head cover and pull from bracket.
- Disconnect fuel injectors harness connector and unclip bracket rail from fuel distributor.
- Unscrew Ground wire between ignition coil -1- and -2-.
- Disconnect connectors from ignition coils.
- Disconnect connector for speedometer Vehicle Speed Sensor -G22- at rear of transmission.
- Remove center, left and right insulation tray:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING** .

- Remove air duct to charge air cooler at lower right of long member.

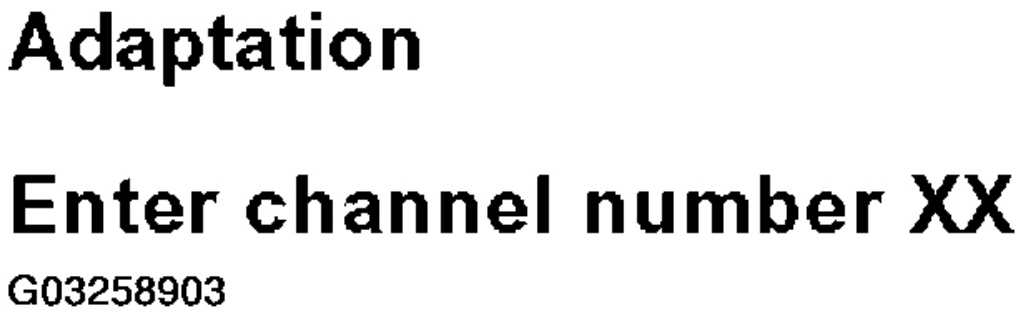

Fig. 7: Removing Air Duct To Charge Air Cooler At Lower Right Of Long Member
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with manual transmission 02J

- Disconnect selector mechanism from transmission.

  See **SELECTOR MECHANISM ON TRANSMISSION SIDE, UP TO 05.99, DISASSEMBLING AND ASSEMBLING** or **SELECTOR MECHANISM ON TRANSMISSION SIDE, AS OF 06.99, DISASSEMBLING AND ASSEMBLING** .

- Remove hydraulic clutch slave cylinder.

  See **CLUTCH SLAVE CYLINDER** .

Vehicles with manual transmission 02M

- Disconnect selector mechanism from transmission.

  See **SELECTOR LEVER LOCK SOLENOID** .

- Remove hydraulic clutch slave cylinder.

  See **CLUTCH RELEASE BEARING/SLAVE CYLINDER** .

  NOTE: Clutch pedal must not be depressed.

Vehicles with automatic transmission

- Remove selector lever cable from transmission:

  See **SELECTOR LEVER CABLE** .

Continued for all vehicles

- Drain coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .

  WARNING: Observe proper disposal regulations!

- Pull radiator coolant hoses off engine.

  NOTE: The VAS 5024 assembly tool or VAG 1921 pliers are recommended for removing and installing the spring-type clamps.

- Remove coolant hoses at heater core.
- Remove coolant hose to coolant pipe at Throttle Valve Control Module -J338-.

- Remove additional fan at right side of vehicle if present.
- Disconnect both harness connectors for cooling fan at notch at left bottom.
- Remove inter-connecting, coolant, vacuum and intake hoses on engine.
- Remove connecting hoses -arrows- between secondary air pump/combi-valve and secondary air pump/air cleaner.

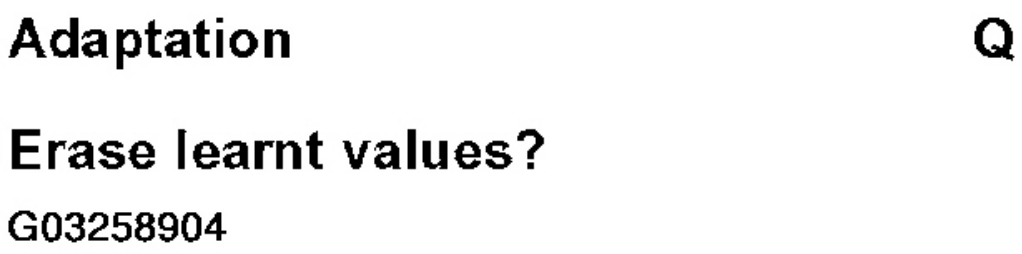

Fig. 8: Removing Connecting Hoses Between Secondary Air Pump/Combi-Valve And Secondary Air Pump/Air Cleaner
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Press buttons on hose couplings to do this.

- Pull connector -1- off secondary air pump.
- Remove secondary air pump motor and bracket.
- Disconnect all electric wires from transmission, alternator and starter and move clear.
- Remove securing clamps for power steering pressure pipe.
- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove power assisted steering vane pump with bracket and lay to side; hoses remain connected.

See **POWER STEERING PUMP, RESERVOIR, HYDRAULIC LINES** .

WARNING: The air conditioner refrigerant circuit must not be opened.

Vehicles with air conditioner

- Remove air conditioner compressor.
- Observe additional notes and assembly work. See **INSTALLATION NOTES** .
- Remove generator.

See **GENERATOR** .

- Remove compact bracket including tightening element for ribbed V-belt. See COMPACT BRACKET , item 22.

Continued for all vehicles

- Remove protective cover for right-hand inner constant velocity joint from engine.
- Remove right-hand drive shaft and disconnect left-hand drive shaft at transmission.

  See **FRONT AXLE SHAFT**

- Remove pendulum support -arrows-.

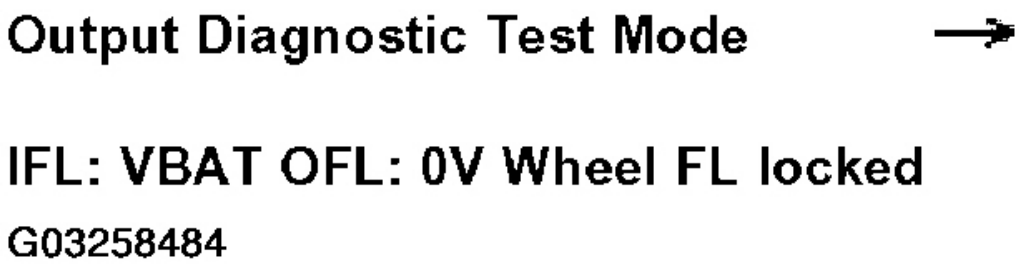

Fig. 9: Removing Pendulum Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove front exhaust pipe with catalytic converter. See **EXHAUST MANIFOLD, FRONT EXHAUST PIPE AND CATALYST WITH ATTACHMENTS** .
- Install engine bracket T 10012 onto cylinder block with a securing nut and M10 X 25/ 8.8 bolt and tighten to approx. 40 N.m.

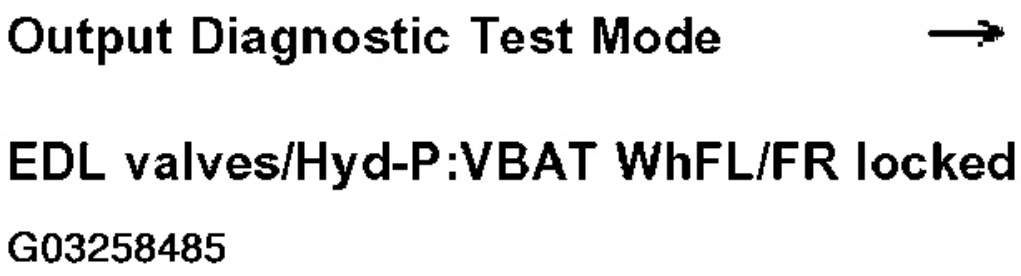

Fig. 10: Installing Engine Bracket T 10012 Onto Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lift engine and transmission lightly using engine/transmission jack VAG 1383 A.
- Unbolt engine side of assembly mount from engine carrier at top -arrows-.

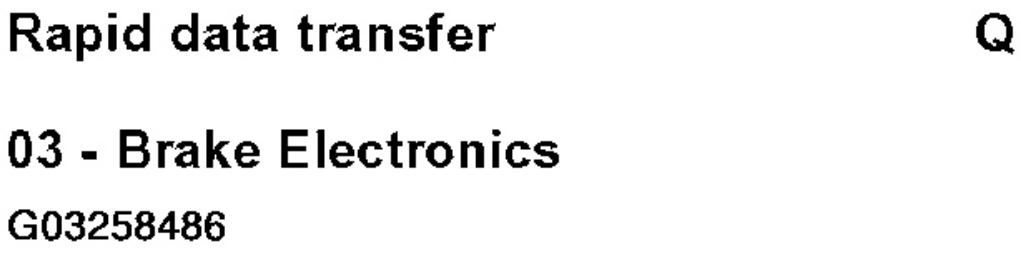

Fig. 11: Unbolting Engine Side Of Assembly Mount From Engine Carrier At Top
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: To remove securing bolts use step ladder VAS 5085.

- Unbolt transmission side of assembly mount from transmission carrier at top -arrows-.

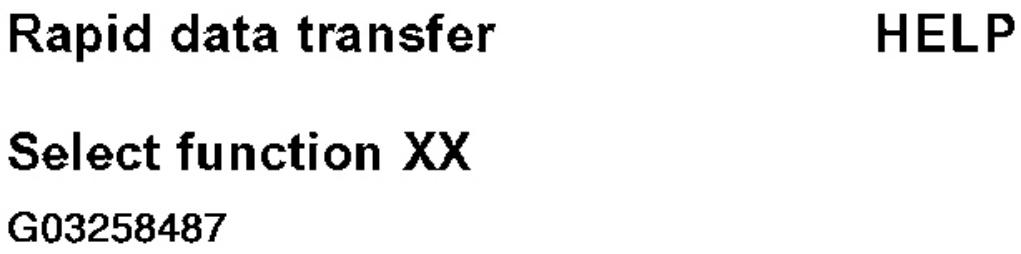

Fig. 12: Unbolting Transmission Side Of Assembly Mount From Transmission Carrier At Top
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully lower engine with transmission and guide power steering pressure line past transmission.

NOTE: Engine with transmission must be guided carefully when lowering to prevent damage to the bodywork.

Engine, securing to assembly stand

When working on the engine, it should be secured to the assembly stand support clamp VW 313 using the engine and transmission bracket VW 540.

Work sequence

- Move engine/transmission with VAG1383 A lift to a workbench.

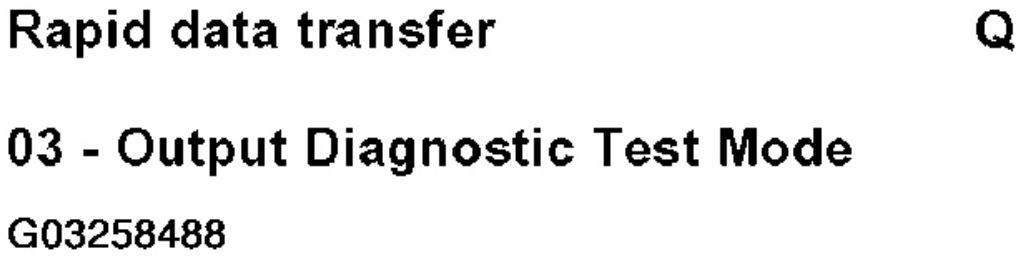

Fig. 13: Moving Engine/Transmission With VAG1383 A And Lifting To Workbench
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lower engine/transmission unit so that transmission is supported (at supporting point).
- Remove transmission.

Vehicles with automatic transmission

- Secure torque converter against "falling out" after separating engine from transmission.

Continued for all vehicles

- Attach lifting tackle 2024 A with bracket 3180 as follows and lift off engine/transmission jack VAG 1383 A with workshop crane VAG 1202 A.

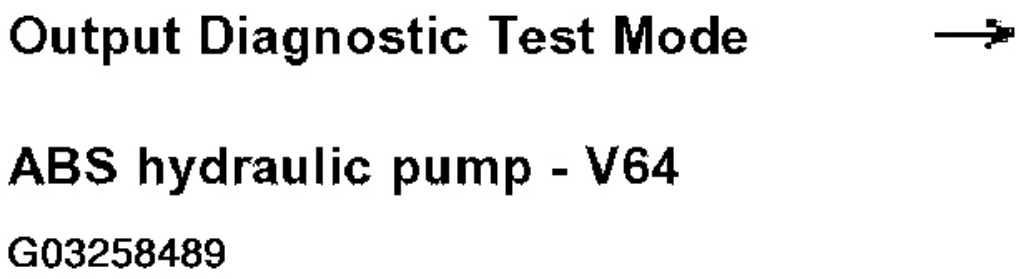

Fig. 14: Attaching Lifting Tackle 2024 A With Bracket 3180 And Lifting Off Engine/Transmission Jack VAG 1383 A
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Pulley end: 3rd hole in hook at position 1

Flywheel end: 2nd hole in hook at position 5

WARNING: The hooks and locating pins must be secured with locking pins.

NOTE:

- **The positions marked 1-4 on the bar must be toward the pulley end.**
- **The holes in the hooks are counted up from the hook.**

- Secure engine to support clamp VW 313 using engine and transmission bracket VW 540.

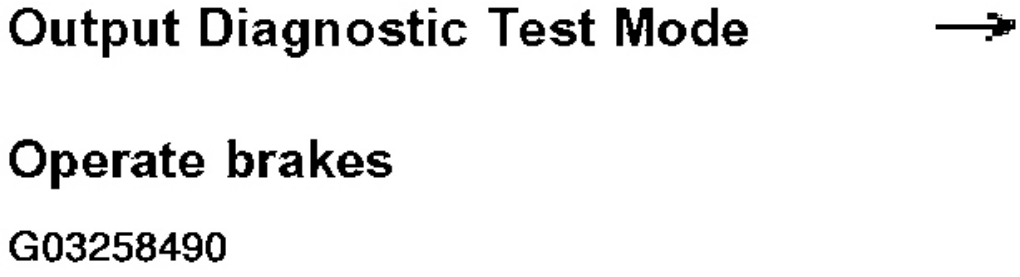

Fig. 15: Securing Engine To Support Clamp VW 313 Using Engine And Transmission Bracket VW 540
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installation notes

Installation is carried out in the reverse sequence. Also note the following:

CAUTION: When doing any repair work, especially in the engine compartment, due to the cramped conditions, pay attention to the following:

- **Route all sorts of lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum lines and hoses, etc.) and electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

- Check whether dowel sleeves for centering engine/transmission are in cylinder block, install if necessary.
- Install intermediate plate onto sealing flange and slide onto dowel sleeves -arrows-.

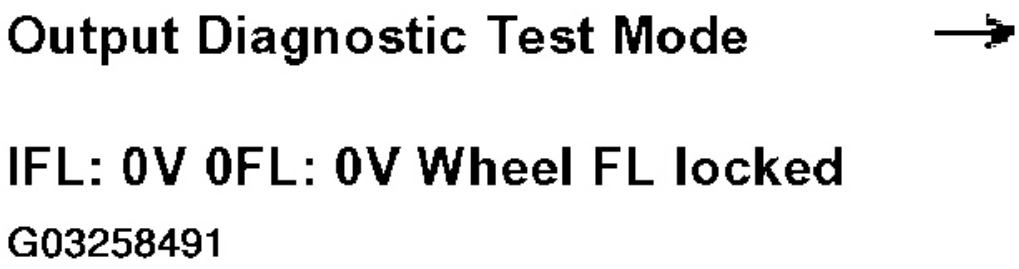

Fig. 16: Installing Intermediate Plate Onto Sealing Flange And Sliding Onto Dowel Sleeves
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with manual transmission

- Check centering of clutch drive plate, if necessary.
- Check clutch release bearing for wear, replace if necessary.
- Lightly grease clutch release bearing, release bearing guide sleeve and splines on input shaft with G 000 100.

Vehicles with manual transmission 02J

- Install hydraulic clutch slave cylinder:

  See **CLUTCH SLAVE CYLINDER**

- Install selector mechanism.

  See **SELECTOR MECHANISM ON TRANSMISSION SIDE, UP TO 05.99, DISASSEMBLING AND ASSEMBLING** or **SELECTOR MECHANISM ON TRANSMISSION SIDE, AS OF 06.99, DISASSEMBLING AND ASSEMBLING**

- If necessary, adjust shifter cables:

  See **SELECTOR MECHANISM**

Vehicles with manual transmission 02M

- Install hydraulic clutch slave cylinder:

  See **CLUTCH RELEASE BEARING/SLAVE CYLINDER**

- Install selector mechanism.

  See **SELECTOR LEVER LOCK SOLENOID**

- If necessary, adjust shifter cables:

  See **SELECTOR MECHANISM**

Vehicles with automatic transmission

- Only use nuts approved in parts program to secure torque converter to drive plate.
- Install selector cable on transmission, adjust if necessary:

  See **SELECTOR LEVER CABLE**

- Adapt control module for automatic transmission:

  See **BASIC SETTING, INITIATING**

Continued for all vehicles

- When installing assembly, ensure sufficient clearance to drive shafts.

Vehicles with air conditioner

- Install generator.

  See **GENERATOR**

- Install compact bracket including tightening element for ribbed V-belt. See COMPACT BRACKET , item 22.

  PART I

- Install A/C compressor.

Continued for all vehicles

- Align engine and transmission mounts. See **ENGINE AND TRANSMISSION MOUNTS, ALIGNING** .
- Install drive shafts:

  See **FRONT AXLE SHAFT**

- Install right hand inner constant velocity joint protective cover from engine.

- Install front exhaust pipe. See **EXHAUST SYSTEM COMPONENTS, REMOVING AND INSTALLING** .
- Install intake hose (between charge air cooler and Throttle Valve Control Module) onto Throttle Valve Control Module -J338- and secure.
- Install power steering pump:

  See **POWER STEERING PUMP IN LOWER SECTION, ASSEMBLY OVERVIEW** or **POWER STEERING PUMP IN UPPER SECTION, ASSEMBLY OVERVIEW**

- Check electrical connections and routing:

  See appropriate WIRING DIAGRAM article.

- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Install center, left and right insulation trays:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

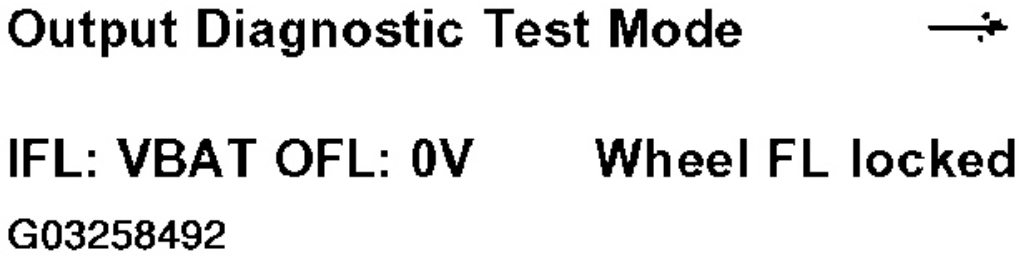

Fig. 17: Installing Center, Left And Right Insulation Trays
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install secondary air pump.
- Install connecting hoses between secondary air pump to combination valve and secondary air pump to air cleaner.
- Fill with coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .
- Perform work sequence "Procedure after correcting voltage supply open circuit".

  See **PROCEDURE AFTER CORRECTING VOLTAGE SUPPLY OPEN CIRCUIT** .

- Test drive vehicle.

Observe the valid safety precautions when carrying out a road test.

See **SAFETY PRECAUTIONS** .

- Check DTC memory and read readiness code:

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC** .

- Generate readiness code again if DTC memory has been erased or engine control module separated from permanent positive.

  See **READINESS CODE**

Tightening torques

TIGHTENING TORQUES

Bolted joint		**Tightening torque**
Bolts, nuts	M6	10 N.m
	M7	15 N.m
	M8	25 N.m
	M10	40 N.m
	M12	60 N.m
Exceptions:		
Engine to transmission connecting bolts	M10	45 N.m
Engine to transmission connecting bolts	M12	80 N.m
Torque converter to drive plate		60 N.m
Drive shaft to joint flange/transmission		40 N.m

NOTE: Assembly mounting tightening torques. See ENGINE/TRANSMISSION MOUNTS .

Engine and transmission mounts, aligning

Engine mount

WARNING: Before loosening the bolts the assemblies must be secured with the special tool 10-222A.

a = 14.0 mm

b = at least 10.0 mm

Both bolt heads 1 must be in flush with edge -c-.

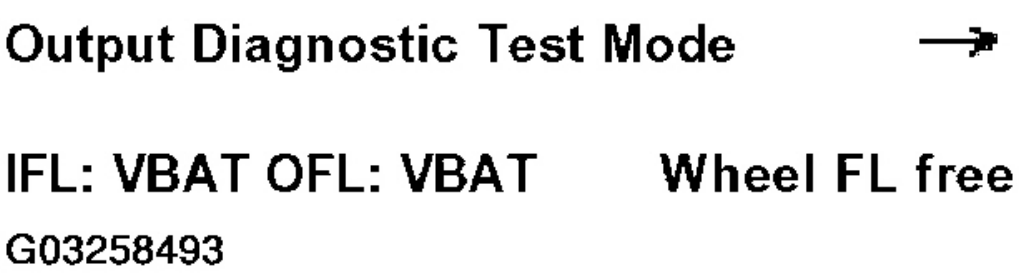

Fig. 18: Aligning Engine Mount
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Transmission mount

Edges -a- and -b- must be parallel with one another.

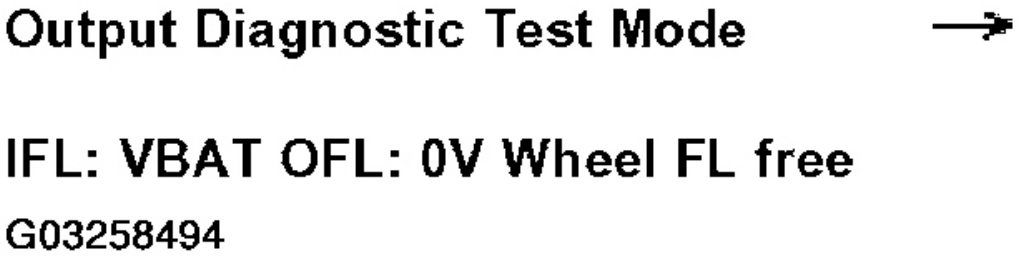

Fig. 19: Aligning Transmission Mount
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine/transmission mounts

Tightening torques

Engine mount

1. Mount to body: 40 N.m + 90° (1/4 turn)

NOTE: Replace bolts

2. Mount/bracket to body: 25 N.m
3. Mount to engine bracket 100 N.m

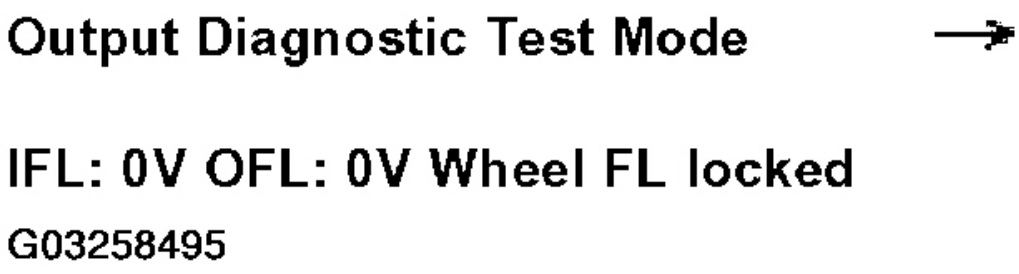

Fig. 20: Engine Mount Tightening Torques
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Transmission assembly mount

1. Mount to body: 40 N.m + 90° (1/4 turn)

NOTE: Replace bolts

2. Mount to body: 25 N.m
3. Mount to transmission console 100 N.m

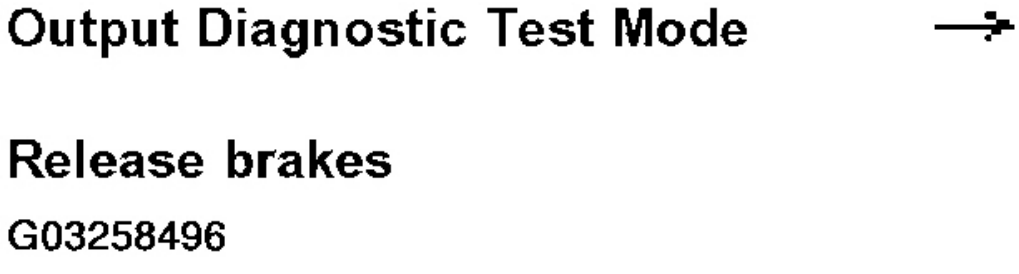

Fig. 21: Transmission Assembly Mount Tightening Torques
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Pendulum support

1. Pendulum support to transmission: 40 N.m + 90° (1/4 turn)

   NOTE: Replace bolts

2. Pendulum support to transmission: 40 N.m + 90° (1/4 turn)

   NOTE: Replace bolts

3. Pendulum support to subframe: 20 N.m + 90° (1/4 turn)

   NOTE: Replace bolts

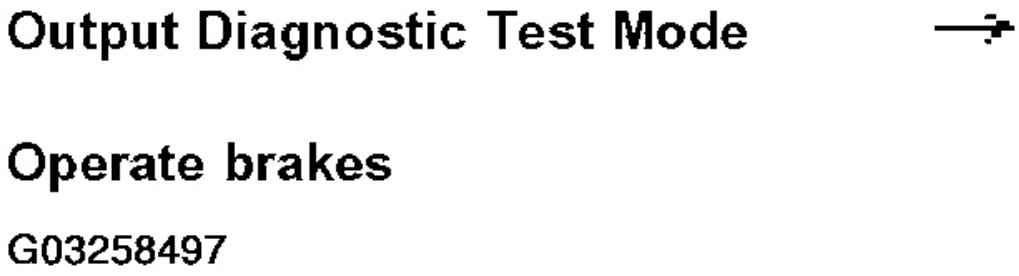

Fig. 22: Pendulum Support Tightening Torques
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Additional information and removal instructions for vehicles with air conditioner

WARNING: The air conditioner refrigerant circuit must not be opened.

NOTE:

- **The refrigerant circuit can only be opened in workshops having specially trained personnel and the necessary tools and workshop equipment.**
- **To prevent damage to condenser and also to the refrigerant lines/hoses, ensure that the lines and hoses are not stretched, kinked or bent.**

To facilitate removing and installing the engine without opening the refrigerant circuit:

- Remove retaining clamp(s) from refrigerant pipes.

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove air conditioner compressor, leaving refrigerant hoses connnected.

  See **COMPRESSOR** .

- Secure air conditioner compressor to towing eye so that refrigerant hoses/lines are not under tension.

NOTE: To prevent damage to bumper protect with adhesive tape.

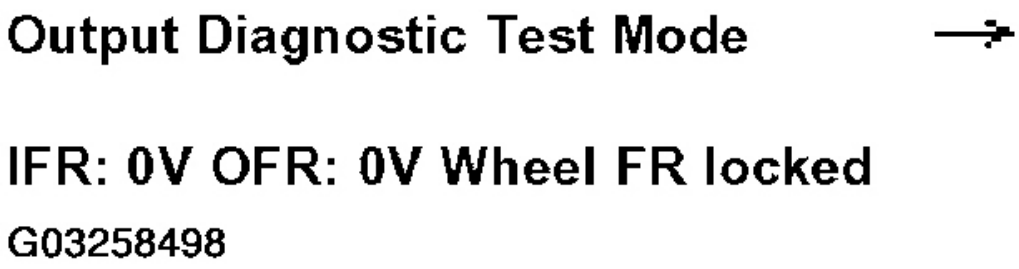

Fig. 23: Securing Air Conditioner Compressor To Towing Eye
Courtesy of VOLKSWAGEN OF AMERICA, INC.

ENGINE - CRANKSHAFT, CYLINDER BLOCK

ENGINE, DISASSEMBLING AND ASSEMBLING

NOTE:

- **When stripping and assembling the engine it should be secured to the engine frar with engine and transmission bracket VW540 and supplementary set VW 540/1B.**
- **If large amounts of material (as metallic particles and abrasive fragments) remove by a cutting or grinding tool or wear are discovered during engine repair work, thi can be from damage to the crankshaft or connecting rod bearings due to partial seizure or oil loss. To prevent any further damage from occurring, carry out the following once the repair procedure is complete:**
  - **Thoroughly clean oil channels**
  - **Replace oil spray jets**
  - **Replace oil cooler**
  - **Replace oil filter**

I. See PART I

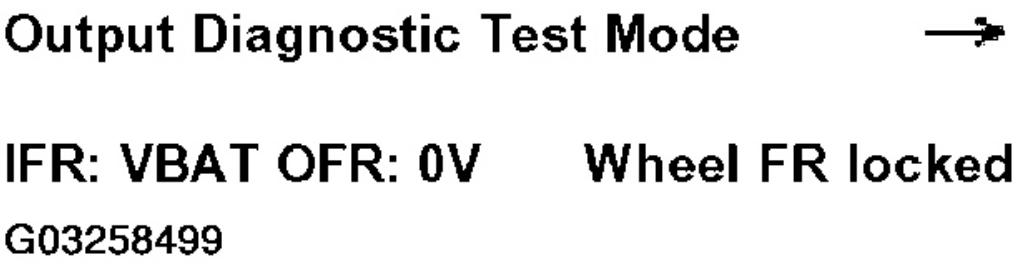

Fig. 24: Disassembling And Assembling Engine
Courtesy of VOLKSWAGEN OF AMERICA, INC.

II. See PART II

PART I

NOTE: The following list refers to items in Fig. 25 .

1. **25 N.m**
2. **Tensioning device for ribbed belt**
   - Turn with open-end spanner to loosen ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
3. **Toothed belt guard - upper part**
4. **Toothed belt guard - center section**
5. **27 N.m**
6. **Idler wheel**
7. **Tensioning roller**
8. **Toothed belt**
   - Mark direction of travel before removing
   - Check for wear
   - Do not kink
   - Removing, installing and tensioning. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING**
9. **Coolant pump**
   - Removing and installing. See **COOLANT PUMP, REMOVING AND INSTALLING**
10. **O-Ring**
    - Always replace if damaged

11. **15 N.m**
12. **Tensioner for toothed belt**
13. **Crankshaft toothed belt sprocket**
14. **15 N.m**
15. **20 N.m**
16. **90 N.m + 1/4 turn (90°) further**
    - Always replace
    - Counter-hold with 3099 to loosen and tighten
    - When bolting on, place two washers between toothed belt pulley and counter-hold
17. **Toothed belt guard - lower part**
18. **10 N.m**
    - Insert with locking fluid D 000 600 A2
19. **Pulley**
    - For power assisted steering pump
20. **25 N.m**
21. **Ribbed belt**
    - Mark direction of rotation before removing
    - Removing and installing. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
22. **25 N.m**
23. **Belt pulley/vibration damper**
    - Can only be installed in one position (holes are offset)
    - Note position when installing toothed belt **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING**

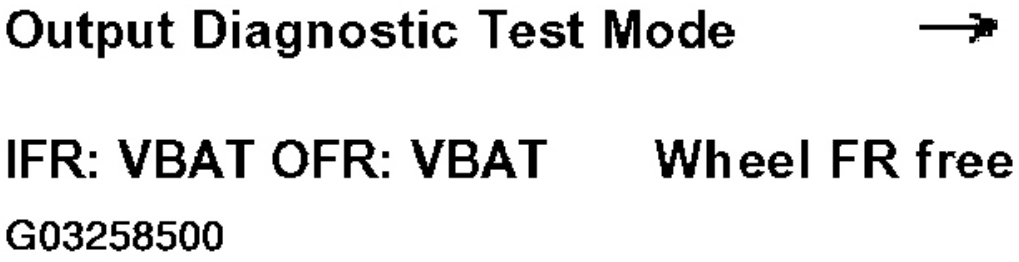

Fig. 25: Exploded View Of Engine (Front Engine Components - Part I
Courtesy of VOLKSWAGEN OF AMERICA, INC.

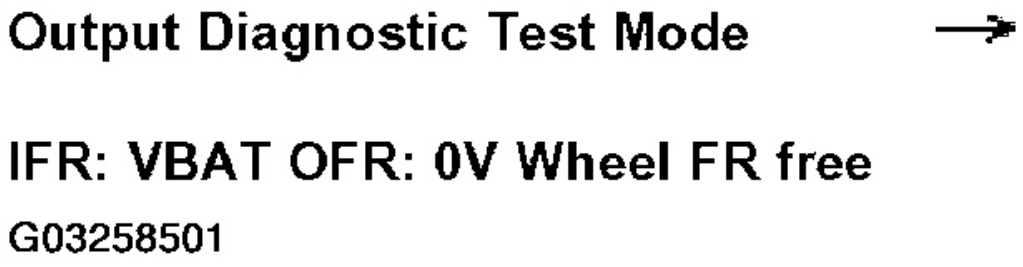

Fig. 26: Exploded View Of Engine (Cylinder Block Components) - Part II
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 26 .

1. **Knock sensor 1 -G61-**
   - Checking:

     See **DTC MEMORY OF MOTRONIC ENGINE CONTROL MODULE, CHECKING AND ERASING**

2. **20 N.m**
   - Tightening torque influences function of knock sensor
3. **Knock sensor 2 -G66-**
   - Checking:

     See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)**

4. **Dipstick**
   - Oil level must not be above the max. mark!
5. **Guide**
   - For dipstick
6. **O-Ring**
   - Always replace
7. **Coolant pipe**
8. **20 N.m**
9. **Oil filter bracket**

- Disassembling and assembling. See **PART II**

10. **15 N.m + 1/4 turn (90°) further**
    - Always replace
11. **Oil cooler**
    - Coat contact area to flange, outside the seal, with AMV188 100 02
    - Ensure clearance to adjacent components
    - Note. See **ENGINE, DISASSEMBLING AND ASSEMBLING**
12. **25 N.m**
13. **Oil filter**
    - Loosen with strap wrench
    - Tighten by hand
    - Note instructions on filter when installing
14. **Gasket**
    - Always replace
15. **10 N.m**
16. **Engine speed sender**
    - Checking:

      See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)**

17. **Connection**
18. **15 N.m**
19. **O-Ring**
    - Always replace
20. **Coolant thermostat**
    - Checking: heat-up thermostat in water
    - Opening commences approx. 86°C
    - Opening lift min. 7 mm
    - Removing and installing. See **THERMOSTAT, REMOVING AND INSTALLING**
    - Observe installation position. See **THERMOSTAT, REMOVING AND INSTALLING**
    - Checking: heat-up thermostat in water
21. **45 N.m**
22. **Compact bracket**
    - For ribbed belt tensioning roller, alternator, power steering pump and air conditioning compressor
23. **Right engine bracket**

Ribbed belt tensioner, removing and installing

Special Tools And Equipment

- 3090 Connecting rod support

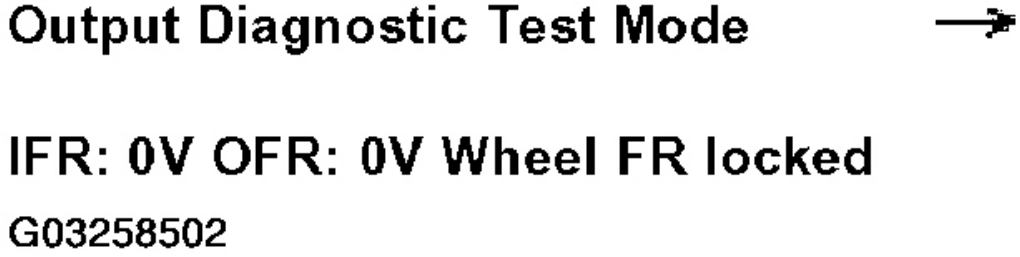

Fig. 27: Identifying 3090 Connecting Rod Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing ribbed belt

- Mark direction of rotation of ribbed belt.
- To loosen ribbed belt turn tensioning element in direction of arrow.

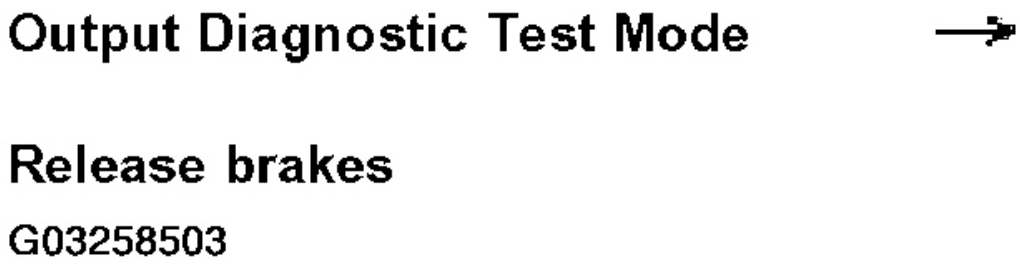

Fig. 28: Loosening Ribbed Belt By Turning Tensioning Element In Direction Of Arrow
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lock tensioning device with 3090 Connecting rod support.

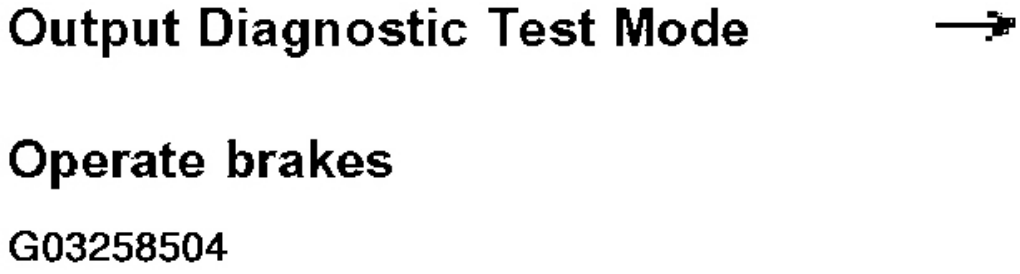

Fig. 29: Identifying Lock Tensioning Device With 3090 Connecting Rod Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove or install ribbed belt.

NOTE: When installing ribbed belts ensure the belt seats correctly in the belt pulley.

- Remove insulation tray.

See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Remove or install ribbed belt.
- Start engine and check belt running.

Ribbed belt routing

Belt drive without air conditioning compressor

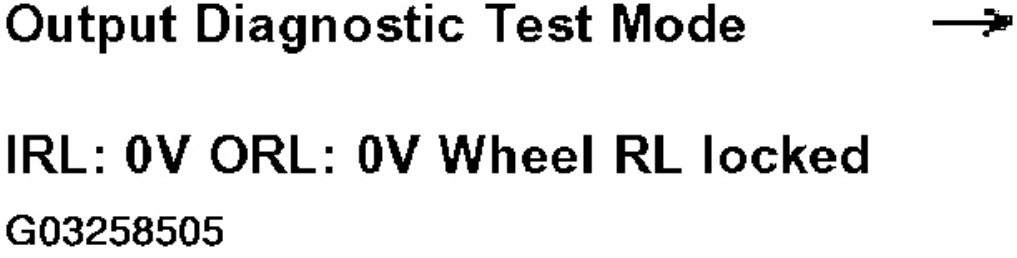

Fig. 30: Identifying Belt Drive Without Air Conditioning Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Belt drive with air conditioning compressor

NOTE: Engines with an air conditioning compressor are equipped with a double ribbed belt.

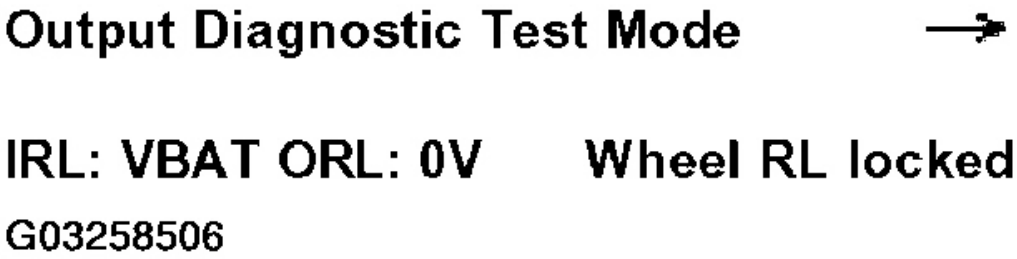

Fig. 31: Identifying Belt Drive With Air Conditioning Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Toothed belt, removing, installing and tensioning

Special tools, workshop equipment, test and measuring appliances and aux. items required

- 10-222A Engine support bracket with 10-222A/8 adapter
- 3180 Retainer (for turbocharged engines)
- T10092 Tensioning bolt

- T40011 Locking pin
- VAG1331 Torque wrench (5 to 50 N.m)
- V.A.G 1332 Torque wrench (40 to 200 N.m)
- D 000 600A2 Locking fluid

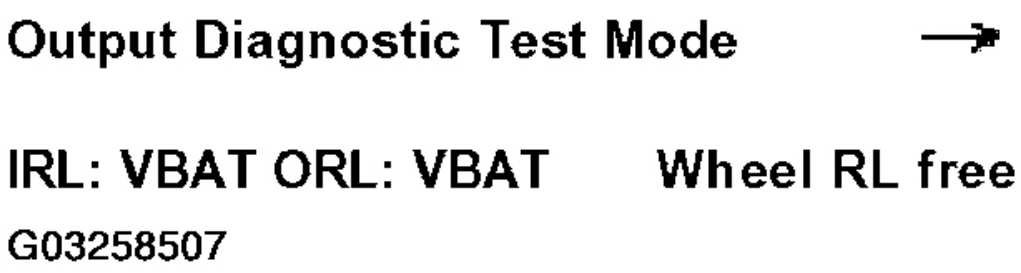

Fig. 32: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Note safety precautions before starting work. See **SAFETY PRECAUTIONS WHEN WORKING ON FUEL SUPPLY**
- Observe rules for cleanliness. See **RULES OF CLEANLINESS** .
- Remove engine cover.
- Remove right-hand insulation tray.

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Remove air duct to charge air cooler at bottom right of long member.

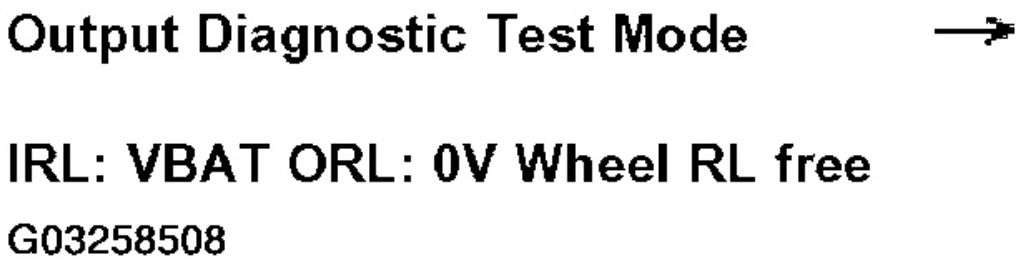

Fig. 33: Removing Air Duct To Charge Air Cooler At Bottom Right Of Long Member
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove tensioning element for ribbed belt.

Engine installed:

- Turn crankshaft to TDC No.1 cylinder (vehicles with manual transmission).

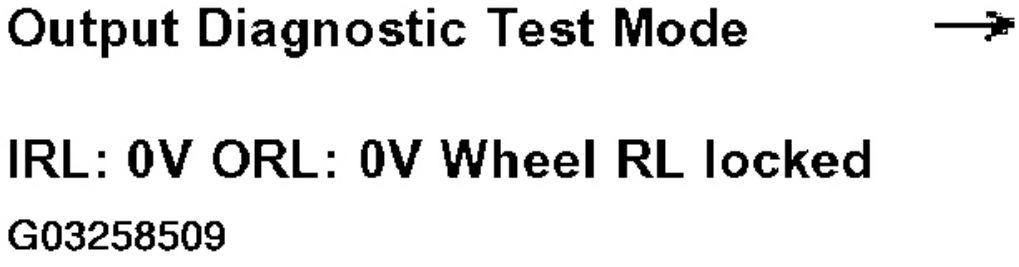

Fig. 34: Turning Crankshaft To TDC No.1 Cylinder (Manual Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to TDC No.1 cylinder (vehicles with automatic transmission).

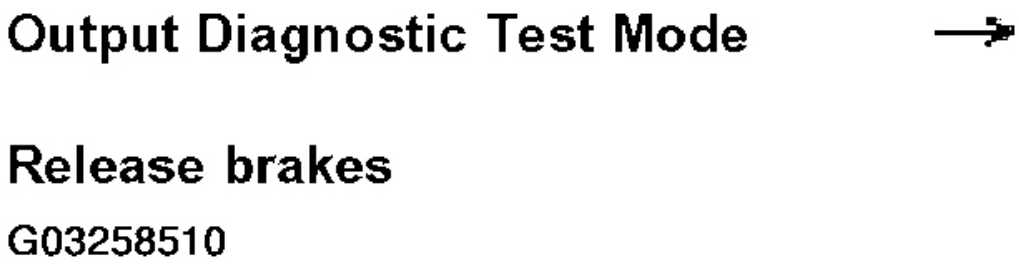

Fig. 35: Turning Crankshaft To TDC No.1 Cylinder (Automatic Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

With engine removed:

- Turn vibration damper to TDC No. 1 cylinder -arrows-.

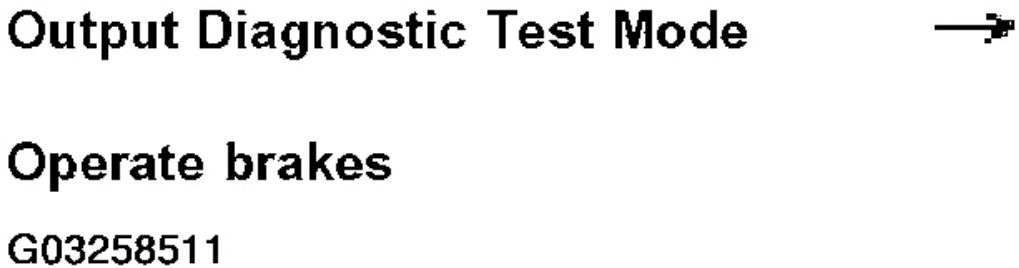

Fig. 36: Turning Vibration Damper To TDC No. 1 Cylinder
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove coolant expansion tank and place to side.
- Pull off vacuum pipes at EVAP canister and at throttle valve housing.
- Remove toothed belt guard (upper part).
- Install engine support bracket 10-222A with legs 10-222A/1.

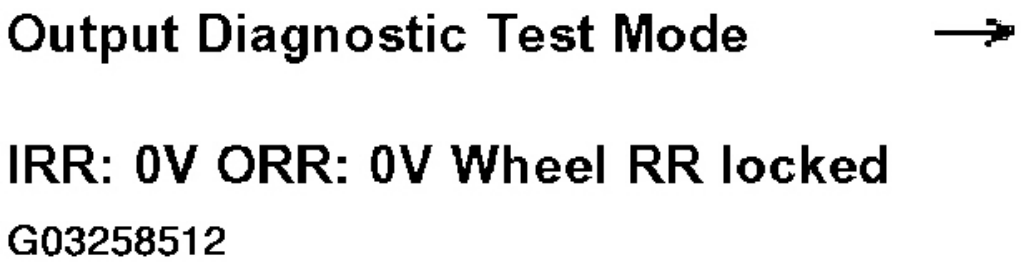

Fig. 37: Installing Engine Support Bracket 10-222A With Legs 10-222A/1
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Locate bracket 3180 in lifting eye on cylinder head and take-up weight of engine.
- Remove securing bolts from assembly mount/engine mount, assembly mount/body and assembly mount/body mount -arrows- and remove assembly mount complete.

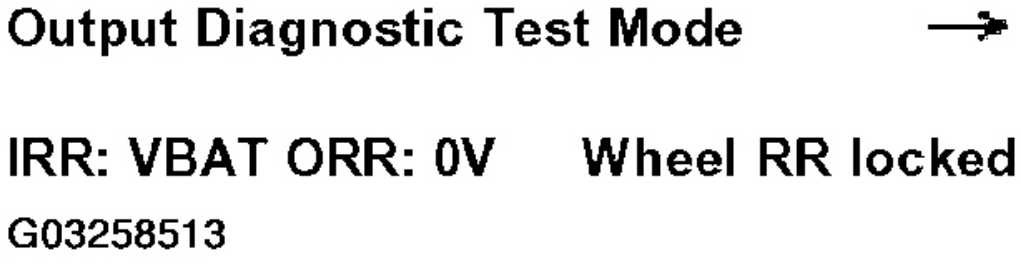

Fig. 38: Assembly Mount/Body Mount Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove vibration damper/belt pulley.
- Remove lower and center toothed belt guard.

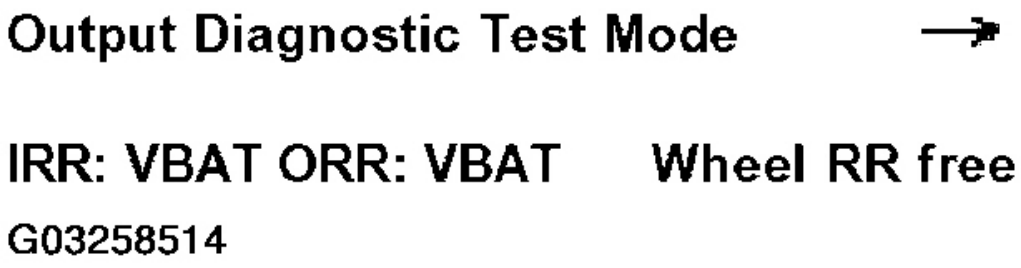

Fig. 39: Removing Vibration Damper/Belt Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove engine bracket from cylinder block.

NOTE: When loosening the front engine mount bolt the engine must be raised slightly with the support bracket.

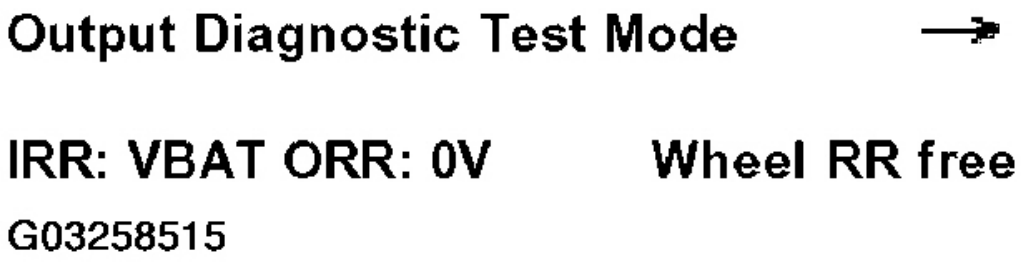

Fig. 40: Removing Engine Bracket From Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Mark direction of rotation of toothed belt.
- Screw tensioning bolt T10092 into toothed belt tensioning element.

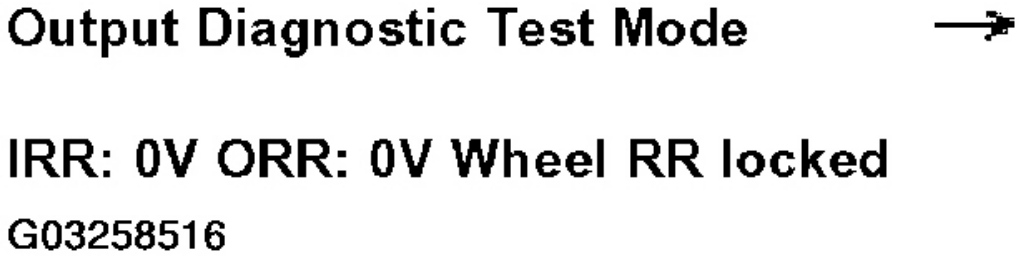

Fig. 41: Screwing Tensioning Bolt T10092 Into Toothed Belt Tensioning Element
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Align pressure piston using pointed pliers or wire before tensioning (hole in pressure piston must align with hole in housing).
- Tension piston of tensioning element just enough that the piston can be locked with locking pin T40011.
- Remove toothed belt.
- Turn crankshaft back slightly.

Installing

NOTE: When turning the camshaft the crankshaft must not be at TDC (danger of damage valves/piston crown).

A - Toothed belt completely removed

If toothed belt has only been removed from camshaft. See **B - TOOTHED BELT ONLY TAKEN OFF CAMSHAFT SPROCKET** .

Conditions

- The pistons must not be positioned at TDC

Work sequence

- Bring mark on camshaft in line with the mark on cylinder head cover.

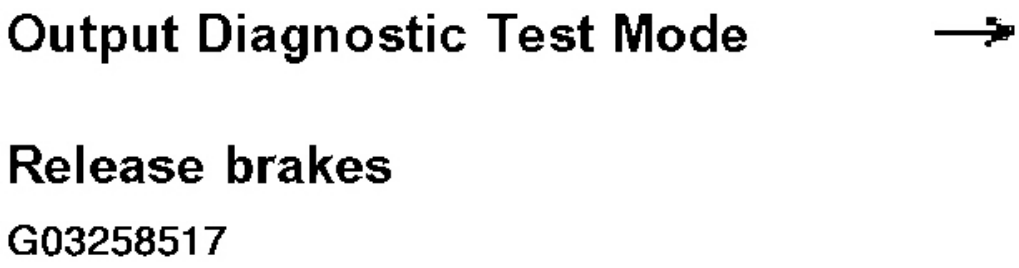

Fig. 42: Aligning Mark On Camshaft With The Mark On Cylinder Head Cover
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Place toothed belt on crankshaft sprocket (observe direction of rotation).
- Install engine mount to cylinder block.

  Tightening torque: 45 N.m

NOTE: Before installing engine mount, insert bolts into mount.

- Install lower part of toothed belt guard. Insert securing bolts with locking fluid "D 000 600 A2".

  Tightening torque: 10 N.m

- Secure vibration damper/belt pulley with one bolt (note fixing arrangement).
- Turn crankshaft to TDC No. 1 cylinder.

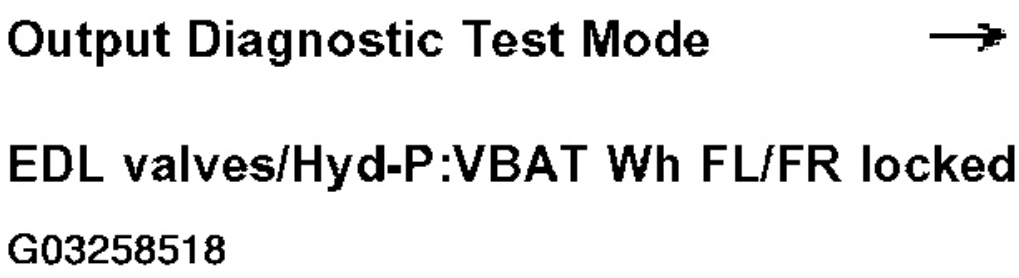

Fig. 43: Turning Crankshaft To TDC No. 1 Cylinder

Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install toothed belt onto coolant pump, tensioning roller and camshaft sprocket.
- Tighten toothed belt. See **TENSIONING TOOTHED BELT** .

B - Toothed belt only taken off camshaft sprocket

- Bring mark on camshaft in line with the mark on cylinder head cover.

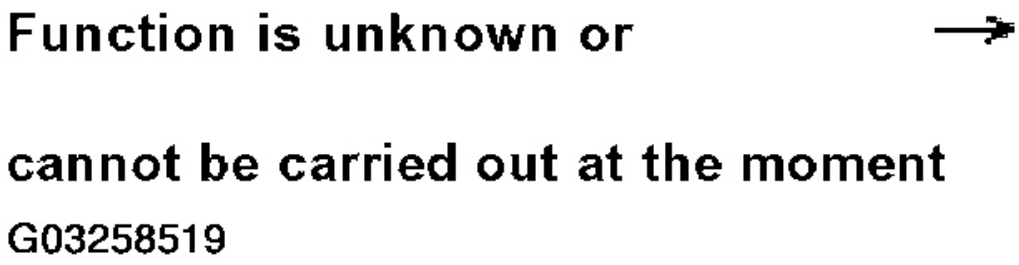

Fig. 44: Aligning Mark On Camshaft With The Mark On Cylinder Head Cover
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to TDC No. 1 cylinder.
- Install toothed belt onto camshaft sprocket.
- Tighten toothed belt. See **TENSIONING TOOTHED BELT**

Tensioning toothed belt

- Tension toothed belt by pulling out locking pin T40011 and removing tensioning bolt T10092.

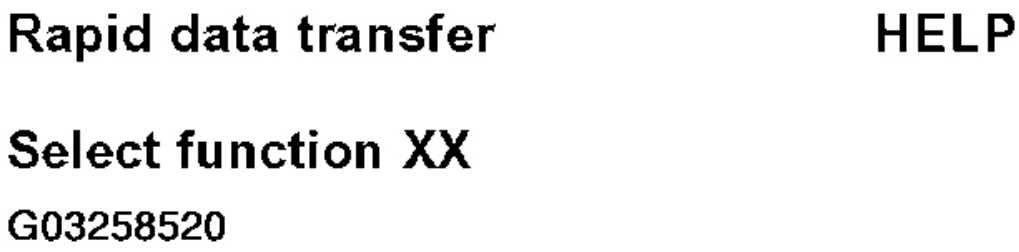

Fig. 45: Tensioning Toothed Belt By Pulling Out Locking Pin T40011 And Removing Tensioning Bolt T10092
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft two full turns and check whether camshaft and crankshaft marks align with their reference points.
- Install vibration damper/belt pulley

  Tightening torque: 25 N.m

- Install center part of toothed belt guard. (Insert securing bolts with locking fluid D 000 600 A2).

  Tightening torque: 10 N.m

- Install upper toothed belt guard.
- Install aggregate mount and engine mount. Tightening torque. See **ENGINE/TRANSMISSION MOUNTS** .
- Install ribbed belt tensioner.

  Tightening torque: 25 N.m

- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Install air duct to charge air cooler at bottom right of long member.
- Install right-hand insulation tray

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

SEALING FLANGES AND DRIVE PLATE, REMOVING AND INSTALLING

NOTE: For repairs to the clutch:

For 02J, see CLUTCH ASSEMBLY

For 02M, see CLUTCH ASSEMBLY

NOTE: The following list refers to items in Fig. 46 .

1. **90 N.m + 1/4 turn (90°) further**
   - Always replace
   - Counter-hold with 3099 to loosen and tighten
   - Threads and shoulder must be free of oil and grease
   - When bolting on, place two washers between toothed belt pulley and counter-hold
2. **Crankshaft toothed belt sprocket**
3. **15 N.m**
4. **Oil seal**
   - Replacing. See **CRANKSHAFT OIL SEAL (BELT PULLEY END), REPLACING**
5. **Sealing flange**
   - Must be located on dowel sleeves
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING**
6. **Cylinder block**
   - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING**
   - Disassembling and assembling pistons and connecting rods. See **PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING**
7. **60 N.m + 1/4 turn (90°) further**
   - Always replace
8. **Flywheel/drive plate**
   - To remove and install flywheel counter-hold with 3067
   - Removing and installing drive plate. See **DRIVE PLATE, REMOVING AND INSTALLING**
9. **Intermediate plate**
   - Must be located on dowel sleeves
   - Do not damage/bend when assembling
10. **Sealing flange with oil seal**
    - Only replace complete
    - Remove oil pan to be able to remove and install. See **OIL PAN, REMOVING AND INSTALLING**
    - Install new sealing flange with fitting sleeve (before installing do not pull sealing sleeve out of oil seal)
    - Before installing, remove oil residue from crankshaft journal using a clean cloth
    - Do not additionally oil or grease the oil seal sealing lip
    - Use protective sleeve supplied when installing

- Remove protective sleeve first after sealing flange has been slid onto crankshaft journal
- Install new sealing flange with fitting sleeve (before installing do not pull sealing sleeve out of oil seal)

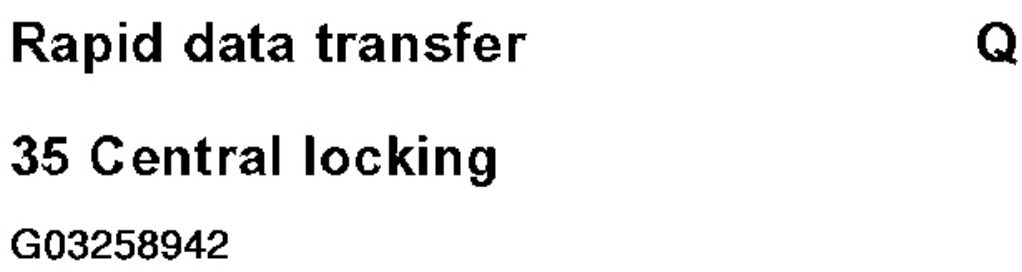

Fig. 46: Identifying Front And Rear Sealing Flanges And Drive Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Crankshaft oil seal (belt pulley end), replacing

Special tools and equipment

- 3099 Counter-hold tool
- VAG 1331 Torque wrench (5-50 N.m)
- VAG 1332 Torque wrench (40-200 N.m)
- 3203 Oil seal extractor
- 2080 A Fitting sleeve
- 3265 Fitting sleeve

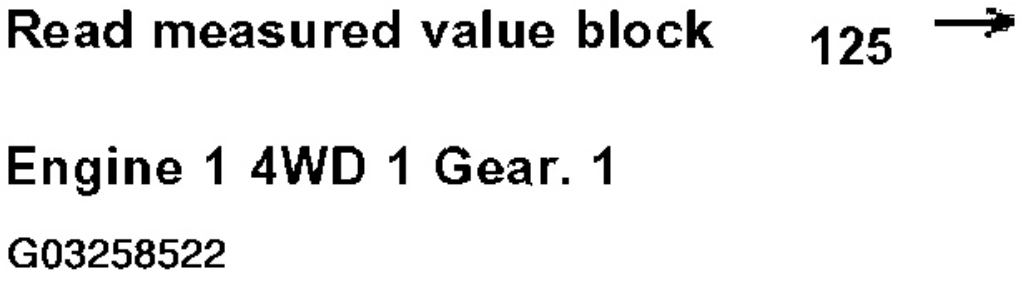

Fig. 47: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove ribbed belt and tensioning element. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove toothed belt. See **REMOVING** .
- Remove crankshaft toothed belt sprocket. To do this counter-hold sprocket with 3099.

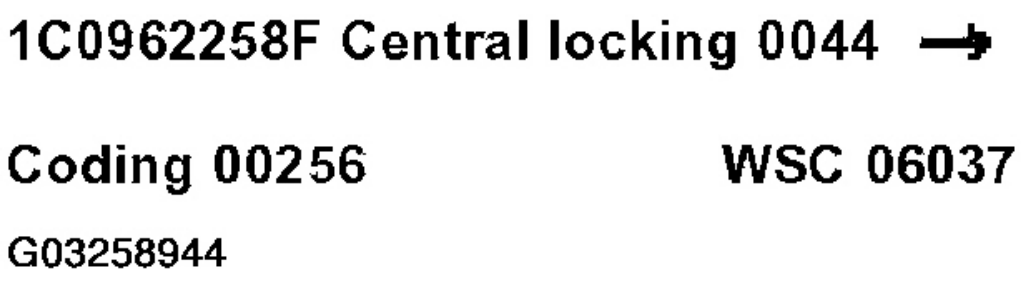

Fig. 48: Removing Crankshaft Toothed Belt Sprocket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: When bolting on counter-hold place two washers between toothed belt pulley and counter-hold.

- To guide seal extractor, screw center bolt into crankshaft onto stop by hand.

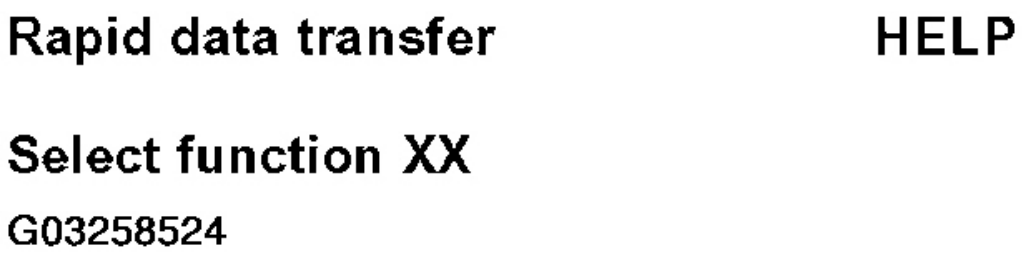

Fig. 49: Screwing Center Bolt Into Crankshaft Onto Stop By Hand
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unscrew inner part of oil seal extractor 3203 nine turns (approx. 20 mm) out of outer part and lock with knurled screw.
- Lubricate threaded head of oil seal extractor 3203, place it in position and exerting firm pressure screw it as far as possible into oil seal.

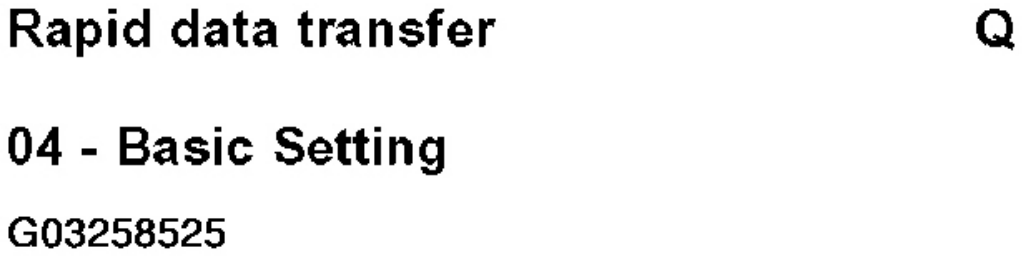

Fig. 50: Lubricating Threaded Head Of Oil Seal Extractor 3203 And Placing In Position And Exerting Firm Pressure Screw
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.

Installing

NOTE: Gradual introduction of PTFE oil seal (identifying characteristics: no annular spring, sealing lip wider). The sealing lip of this oil ring must not be oiled or lubricated. A plain encased seal of older construction (with annular spring) may

be replaced with a PTFE oil seal, but not vice versa.

- Install guide sleeve from 2080 A onto crankshaft journal.

Fig. 51: Installing Guide Sleeve From 2080 A Onto Crankshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve onto crankshaft stub.
- Press in seal with press sleeve from 3265. To do this use old central bolt for crankshaft toothed belt sprocket.

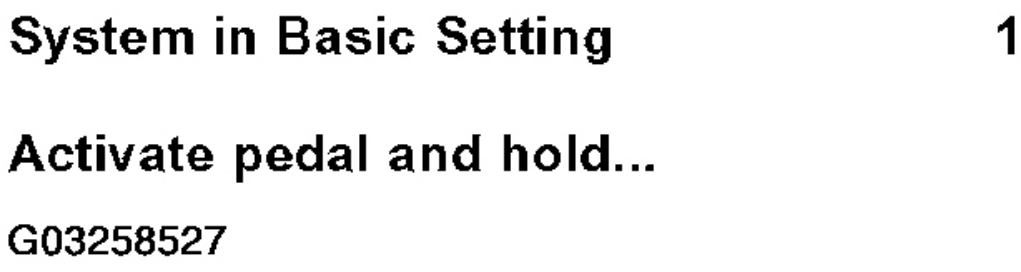

Fig. 52: Pressing In Seal With Press Sleeve From 3265
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press sleeve in onto stop.
- Install crankshaft toothed belt sprocket and hold with counter-hold tool 3099.

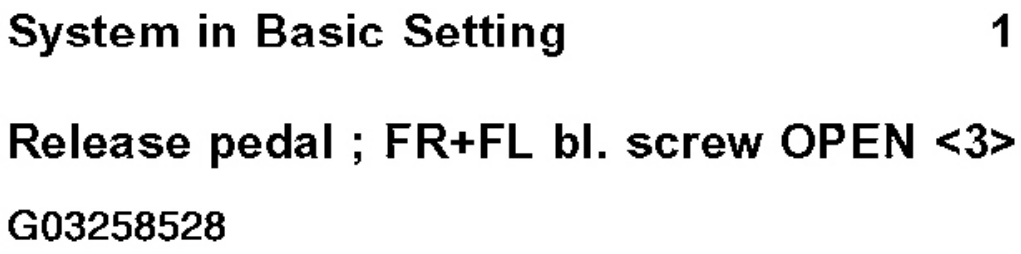

Fig. 53: Installing Crankshaft Toothed Belt Sprocket And Holding With Counter-Hold Tool 3099
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten new central bolt to 90 N.m + 1/4 turn (90°) further.

NOTE:

- **When bolting on, place two washers between toothed belt pulley and counter-hold.**
- **Thread and shoulder must be free of oil and grease.**

- Install toothed belt and adjust valve timing. See **INSTALLING** .
- Install ribbed belt and tensioning element. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .

Front sealing flange, removing and installing

Special tools and equipment

- 3099 Counter-hold tool
- 2080 A Fitting sleeve
- VAG 1331 Torque wrench (5-50 N.m)
- VAG 1332 Torque wrench (40-200 N.m)
- D 176 404 A2 Silicone sealant
- Hand drill with plastic brush wheel
- Flat scraper
- Protective glasses

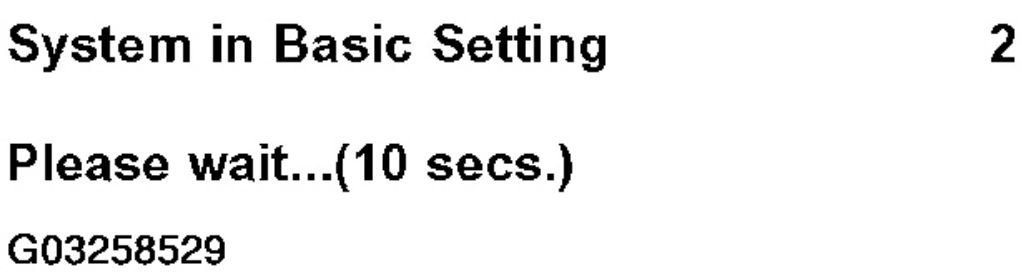

Fig. 54: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove ribbed belt and tensioning element. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove toothed belt. See **REMOVING** .
- Remove crankshaft toothed belt sprocket. To do this counter-hold sprocket with 3099.

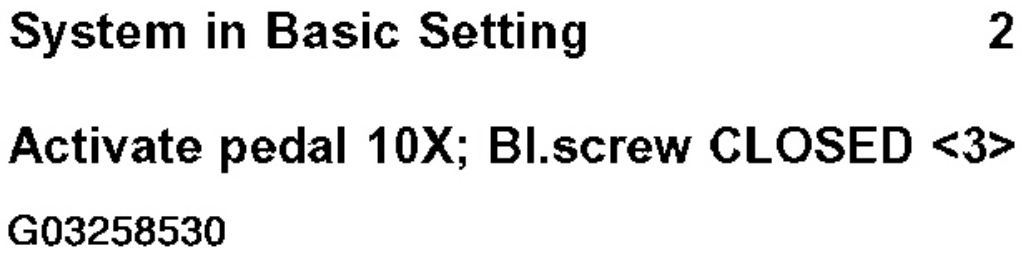

Fig. 55: Removing Crankshaft Toothed Belt Sprocket By Counter-Holding Sprocket With 3099
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: When bolting on, place two washers between toothed belt pulley and counter-hold.

- Remove oil pan. See **OIL PAN, REMOVING AND INSTALLING** .
- Unbolt front sealing flange.

- Take off sealing flange, release using light blows with a rubber headed hammer if necessary.
- Remove sealant residue on cylinder block with a flat scraper.
- Remove sealant remains on sealing flange with a rotating plastic brush (wear protective goggles).

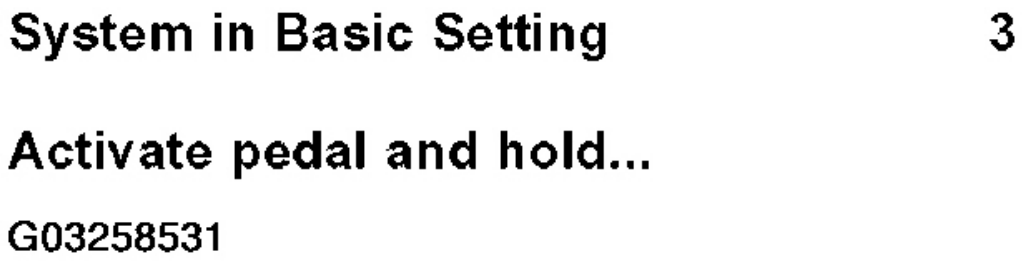

Fig. 56: Removing Sealant Remains On Sealing Flange With Rotating Plastic Brush
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Clean sealing surface, must be free of oil and grease.

Installing

NOTE:

- **Note the "use by" date of the sealant.**
- **The sealing flange must be installed within 5 minutes o applying the silicone sealant.**

- Cut-off tube nozzle at forward marking (nozzle approx. 3 mm diameter).
- Apply silicone sealing compound to clean oil pan sealing surface as shown.

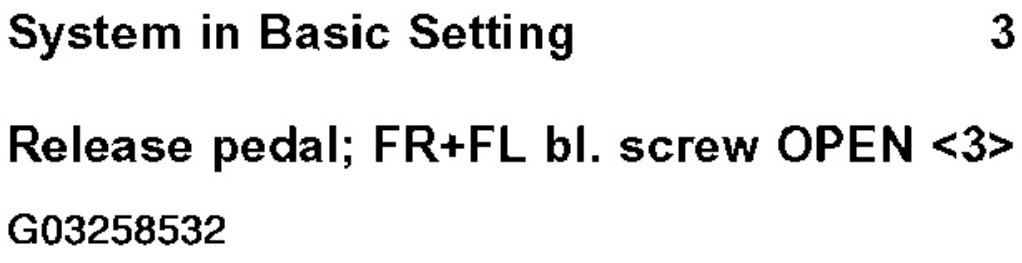

Fig. 57: Applying Silicone Sealing Compound To Clean Oil Pan Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Thickness of sealant bead -arrows-: 2 - 3 mm

NOTE: The sealing compound bead must not be thicker, otherwise excessive sealing compound will enter the oil pan and may block the oil suction pipe strainer.

- Apply silicone sealant bead as shown to clean sealing surface of sealing flange.

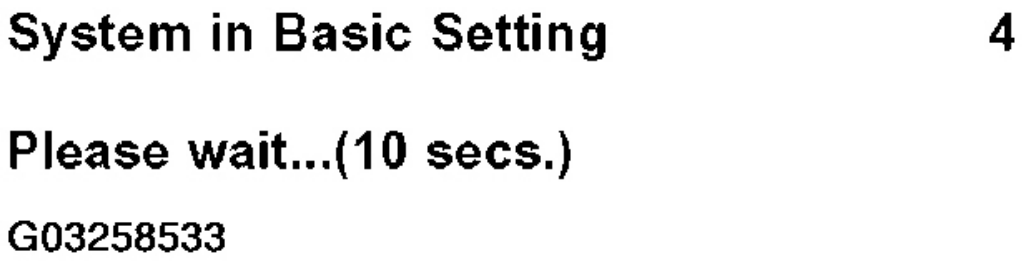

Fig. 58: Applying Silicone Sealant Bead To Clean Sealing Surface Of Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install sealing flange immediately and lightly tighten all bolts.

NOTE: Use guide sleeve from 2080A to install sealing flange with the oil seal already installed.

- Tighten sealing flange securing bolts using alternate sequence.

Tightening torque: 15 N.m

- Remove excess sealant.
- Install oil pan. See **OIL PAN, REMOVING AND INSTALLING** .

NOTE: After installing, the sealant must be allowed to dry for approx. 30 minutes before engine oil is filled.

- Install crankshaft toothed belt sprocket and hold with counter-hold tool 3099.

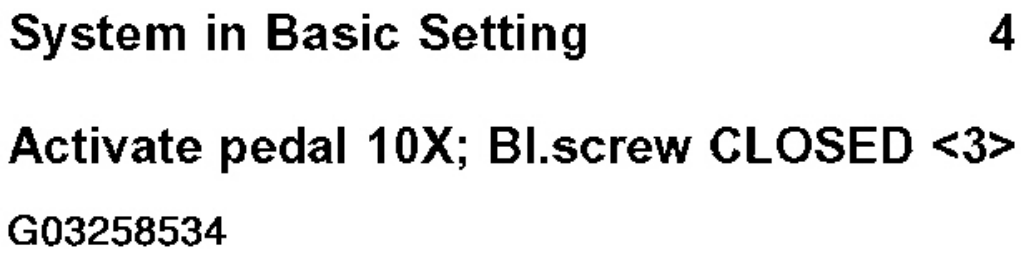

Fig. 59: Installing Crankshaft Toothed Belt Sprocket And Holding With Counter-Hold Tool 3099
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten new central bolt to 90 N.m + 1/4 turn (90°) further.
- Install compact bracket including tightening element for ribbed V-belt. See) COMPACT BRACKET .

NOTE:

- **When bolting on, place two washers between toothed belt pulley and counter-hold.**
- **Thread and shoulder must be free of oil and grease.**

- Install toothed belt and adjust valve timing. See **INSTALLING** .
- Installing ribbed belt and tensioning element. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .

Drive plate, removing and installing

Special tools and equipment

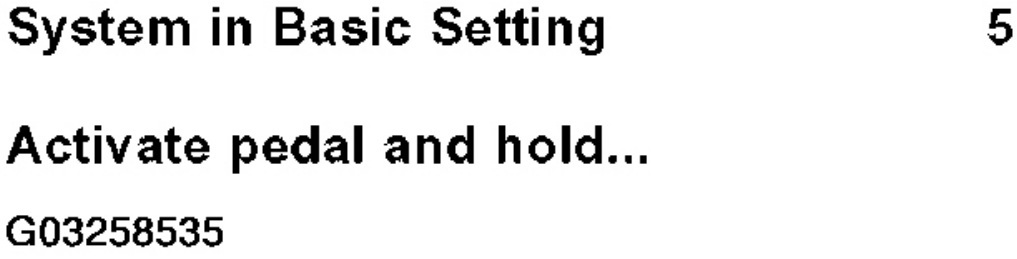

Fig. 60: Identifying VW 558 Retainer
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VW 558 Retainer
- Hex bolt M8x45 and two M10 hex nuts
- Depth gauge

Loosening and tightening drive plate

- Secure counter-hold tool VW 558 to the drive plate with a hex bolt M8x45. Place two M10 hex nuts -1- between counter-hold tool and drive plate.

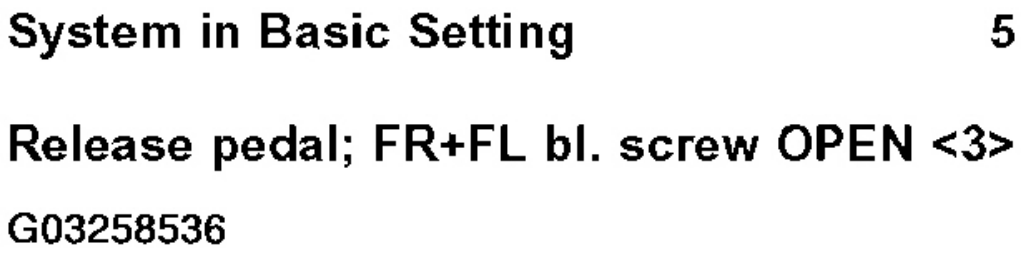

Fig. 61: Securing Counter-Hold Tool VW 558 To The Drive Plate With Hex Bolt M8x45
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen drive plate bolts.

Installing drive plate

- Locate drive plate and packing plate with recesses -1-.
- Install new bolts -3- and tighten to 30 N.m.

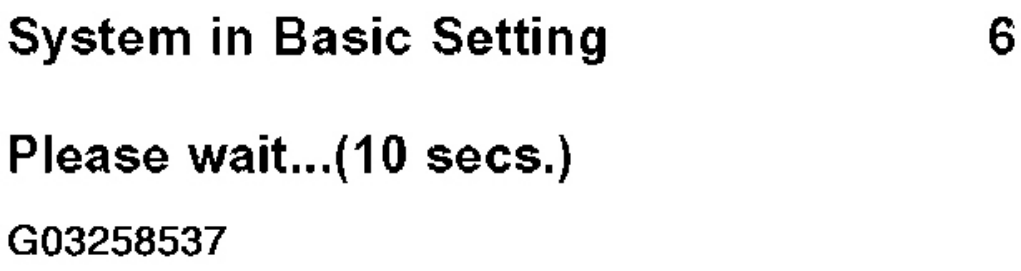

Fig. 62: Locating Drive Plate And Packing Plate With Recesses
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check dimension -a- at three points and calculate average.

  Specification: 19.5 to 21.1 mm

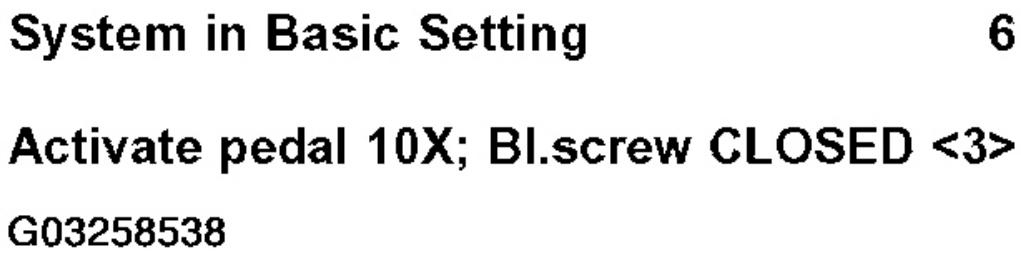

Fig. 63: Measuring Dimension Through Hole In Drive Plate To Milled Surface Of Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Measured through hole in drive plate to milled surface of cylinder block.

If the specification is not attained:

- Remove drive plate again and fit shim -2-. Tighten bolts again to 30 N.m.

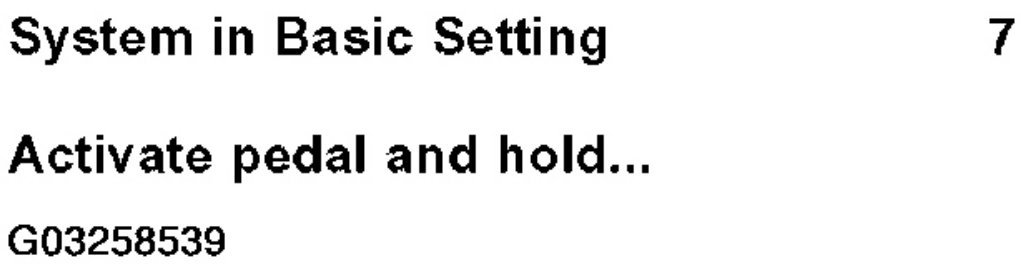

Fig. 64: Removing Drive Plate And Shim
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten bolts to 60 N.m and turn 90° (1/4 turn) further (turning further can be done in several stages).

CRANKSHAFT, REMOVING AND INSTALLING

NOTE:

- **Before removing the crankshaft, prepare a suitable surface so that the sensor wheel (item 8) is not making contact with anything and is not damaged.**
- **When stripping and assembling the engine it should be secured to the engine frame with engine and transmission bracket VW 540 and supplementary set VW 540/1B.**

NOTE: The following list refers to items in Fig. 65 .

1. **Oil pump**
   - With pressure relieve valve of 12 bar
   - Before installing, check that both dowel sleeves for centering oil pump/cylinder head are installed
   - Removing and installing. See **LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING**
2. **15 N.m**
3. **Chain sprocket**
   - For oil pump drive
   - Check for wear
4. **Bearing caps 1, 2, 4 and 5**
   - For bearing cap without oil groove
   - For cylinder block with oil groove
   - Do not interchange used bearing shells (mark)

- Classification for ordering replacement parts. See **Upper Crankshaft Bearing Identification**

5. **65 N.m + 90° (1/4 turn) further**
   - Replacing
   - Threaded along complete length (screw)
   - Tighten to 65 N.m when measuring radial clearance
6. **Bearing cap**
   - Bearing cap 1: pulley end
   - Bearing cap 3 with recesses for thrust washers
   - Bearing shell retaining lugs (cylinder block/bearing cap) must be on the same side
7. **Bearing shell 3**
   - For bearing cap without oil groove
   - For cylinder block with oil groove
   - Do not interchange used bearing shells (mark)
8. **Sensor wheel**
   - Always replace
   - For engine speed (RPM) sensor -G28-
   - Can only be installed in one position (holes are offset)
9. **10 N.m + 1/4 turn (90°) further**
   - Always replace
10. **Thrust washer**
    - For bearing 3 bearing cap
    - Note fixing arrangement
11. **Crankshaft**

    Axial clearance:

    - New: 0.07-0.23 mm
    - Wear limit: 0.30 mm

    Checking radial clearance with Plastigage:

    - New: 0.01-0.04 mm
    - Wear limit: 0.15 mm
    - Do not rotate the crankshaft when checking the radial clearance
    - Crankshaft dimensions. See **CRANKSHAFT DIMENSIONS**

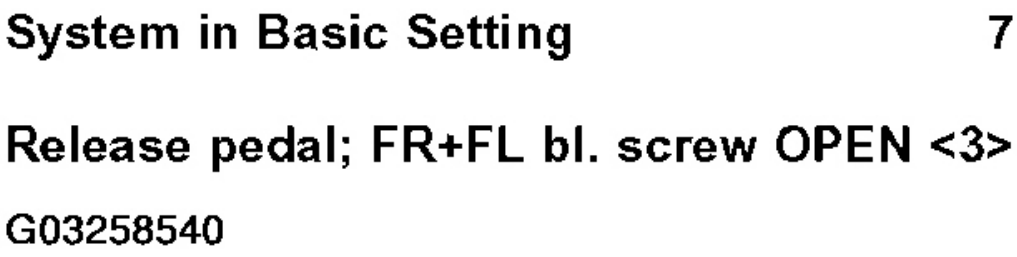

Fig. 65: Exploded View Of Crankshaft Assembly & Oil Pump
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Upper Crankshaft Bearing Identification

Vehicles from approx. 05.00

The upper crankshaft bearings are installed with the proper thickness bearing shells from the factory. Color points are used to identify the bearing shell thickness.

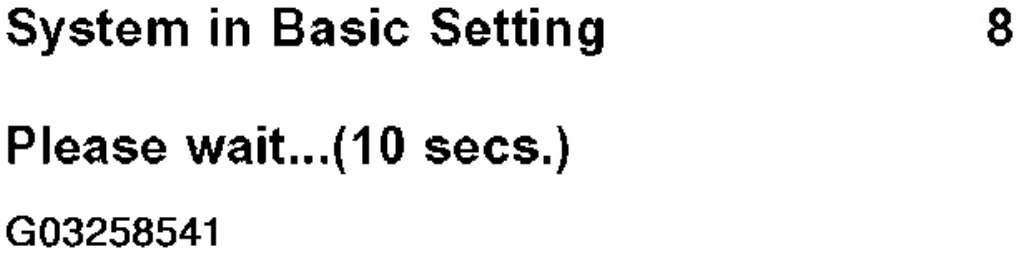

Fig. 66: Identifying Upper Crankshaft Bearing Identification Markings On Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The arrow shows drive direction.

Letters in the lower sealing surface of the cylinder block identify which bearing thickness must be installed at which position.

Color markings

CRANKSHAFT BEARING COLOR MARKINGS

Letter in cylinder block	Bearing color
S =	black
R =	red
G =	yellow

The lower crankshaft bearing shells are always supplied as a replacement part with the color marking "yellow".

Crankshaft dimensions

(in mm)

CRANKSHAFT DIMENSIONS

Honing dimension	Main journal diameter (mm)	Connecting rod journal diameter (mm)
Basic dimension	-0.017 54.00 -0.037	-0.022 47.80 -0.042
1st undersize	-0.017 53.75 -0.037	-0.022 47.55 -0.042
2nd undersize	-0.017 53.50 -0.037	-0.022 47.30 -0.042
3rd undersize	-0.017 53.25 -0.037	-0.022 47.05 -0.042

PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING

Vehicles with engine code APH

For vehicles with engine code AWP or AWV, see **VEHICLES WITH ENGINE CODE AWP, AWV** .

NOTE: Secure engine to engine bracket VW 540 on assembly stand when dissembling/assembling engine.

NOTE: The following list refers to items in Fig. 67 .

1. **Piston ring**
   - Offset gaps by 120°
   - Remove and install with piston ring pliers
   - "TOP" faces toward piston crown
   - Checking ring gap. See **Checking Piston Ring Gap**

- Checking ring to groove clearance. See **Checking Ring To Groove Clearance**
- 2 or 3 part oil scraper ring, mixed installations permissible

2. **Piston**
   - Checking. See **Checking Piston**
   - Mark installation position and cylinder number
   - Arrow on piston crown points to pulley end
   - Install using piston ring clamp
3. **Connecting rod**
   - Only replace as a set
   - Mark cylinder number -B-
   - Installation position: Marking -A- faces toward pulley end
4. **Connecting rod bearing cap**
   - Note installation position
   - Installation position: Marking -A- faces towards pulley end
   - Mark cylinder number -B-
5. **30 N.m + 1/4 turn (90°) further**
   - Always replace
   - Oil threads and contact surface
   - To measure radial clearance tighten to 30 N.m but not further
6. **Pressure relief valve, 27 N.m**
   - Opening pressure: 1.3 to 1.6 bar
7. **Oil spray jet**
   - For piston cooling
8. **Bearing shell**
   - Note installation position
   - Do not interchange used bearing shells
   - Ensure retaining lugs fit tightly in recesses
   - Axial clearance New: 0.10-0.31 mm Wear limit: 0.40 mm

     Check radial clearance with Plastigage:

   - New: 0.01-0.05 mm
   - Wear limit: 0.09 mm
   - Do not rotate crankshaft when checking radial clearance
9. **Cylinder block**
   - Checking cylinder bores. See **Checking Cylinder Bores**
   - Piston and cylinder dimensions. See **PISTON AND CYLINDER DIMENSIONS (ENGINE CODE: APH)**

10. **Connecting rod bolt**
    - Always replace
11. **Circlip**
12. **Piston pin**
    - If difficult to remove, heat piston to 60° C
    - Remove and install with VW 222a

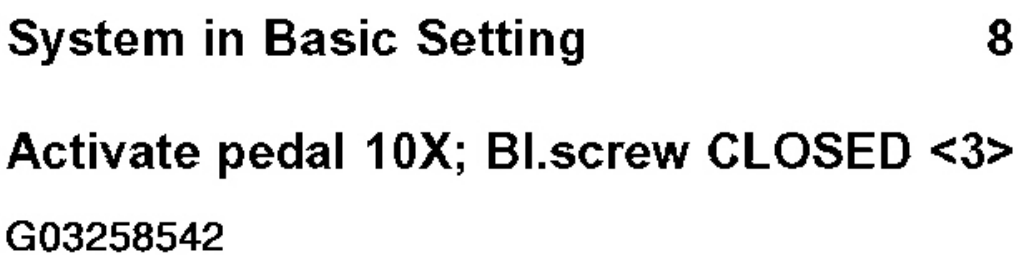

Fig. 67: Exploded View Of Pistons And Connecting Rods (Engine Code APH)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Piston Ring Gap

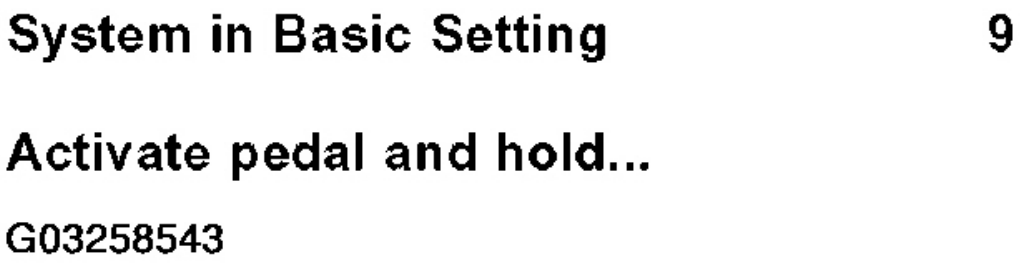

Fig. 68: Checking Piston Ring End Gap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Feeler gauges

- Push ring squarely from above down to approx. 15 mm from bottom end of cylinder.

PISTON RING END GAP (ENGINE CODE APH)

Piston ring	Gap	
New		Wear limit
Compression mm rings	0.15-0.40	0.8
Oil scraper ring mm	0.25-0.50	1.0

Checking Ring To Groove Clearance

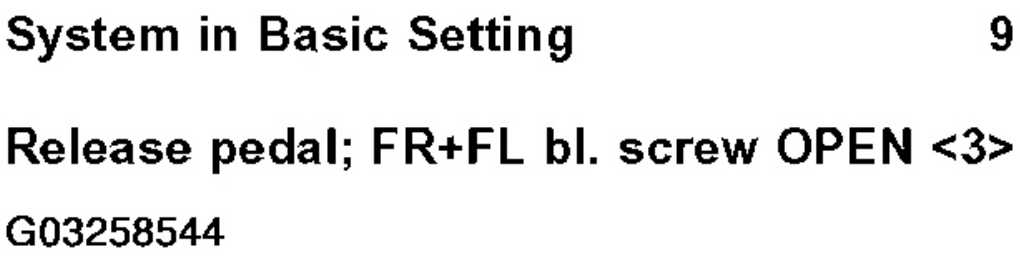

Fig. 69: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Feeler gauges
- Clean groove before check.

PISTON RING-TO-GROOVE CLEARANCE (ENGINE CODE APH)

	Clearance	
Piston ring	New	Wear limit
Compression rings mm	0.02-0.07	0.12
Oil scraper ring mm	0.02-0.06	0.12

Checking Piston

Special tools and equipment

- Micrometer 75-100 mm
- Measure pistons approx. 10 mm from lower edge of skirt, at 90° to piston pin axis.

Deviation from nominal dimension max.: 0.04 mm

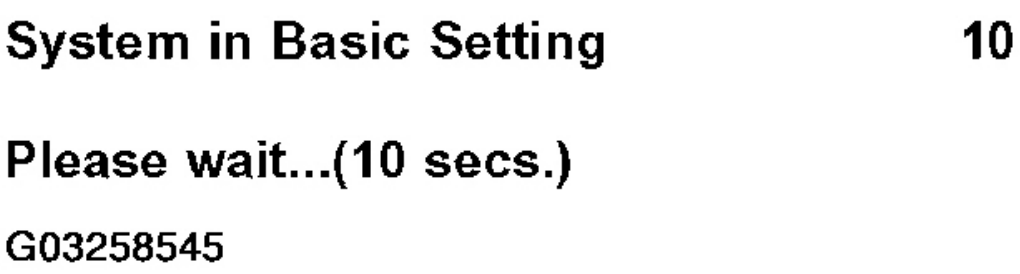

Fig. 70: Checking Piston Skirt Diameter
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Cylinder Bores

Special tools and equipment

- Internal dial indicator 50-100 mm
- Measure bores at 3 locations in both directions -A- across engine and -B- in line with crankshaft.

  Deviation from nominal dimension max.: 0.10 mm

NOTE: Measuring the cylinder bores must not be done when the cylinder block is mounted on a repair stand with adapter bracket VW 540, as incorrect measurements would then be possible.

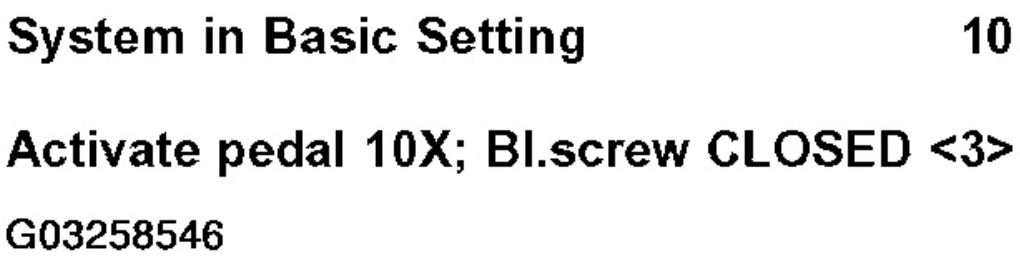

Fig. 71: Checking Cylinder Bores
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Piston and cylinder dimensions (engine code: APH)

PISTON AND CYLINDER DIMENSIONS (ENGINE CODE APH)

Honing dimension	Piston diameter	Cylinder bore diameter
Basic dimen. mm	80.965 (1)	81.01
1st oversize mm	81.465 (1)	81.51
(1) Dimension without graphite coating (thickness 0.02 mm). The graphite coating wears away.		

Vehicles with engine code AWP, AWV

NOTE: The following list refers to items in Fig. 72 .

1. **Piston ring**
   - Offset gaps by 120°
   - Remove and install with piston ring pliers
   - "TOP" faces toward piston crown
   - Checking ring gap. See **Checking Piston Ring Gap**
   - Checking ring to groove clearance. See **Checking Ring To Groove Clearance**
2. **Piston**
   - Checking. See **Checking Piston**
   - Mark installation position and cylinder number
   - Arrow on piston crown points to pulley end
   - Install using piston ring clamp
3. **Piston pin**
   - If difficult to remove, heat piston to 60 °C
   - Remove and install with VW 222a
4. **Circlip**
5. **Connecting rod**
   - Only replace as a set
   - Mark cylinder number -B-
   - Installation position: Marking -A- faces toward pulley end
6. **Bearing shell**
   - Note installation position
   - Do not interchange used bearing shells
   - Axial clearance

New: 0.05 to 0.31 mm

Wear limit: 0.37 mm

- Check radial clearance with Plastigage:

  New: 0.01 to 0.06 mm

  Wear limit: 0.09 mm

- Do not rotate crankshaft when checking radial clearance

7. **Cylinder block**
   - Checking cylinder bores. See **Bearing Shells - Mount**
   - Piston and cylinder dimensions. See **PISTON AND CYLINDER DIMENSIONS (ENGINE CODES: AWP, AWV)**
8. **Connecting rod bearing cap**
   - Note installation position
9. **Oil spray jet**
   - For piston cooling
10. **Pressure relief valve, 27 N.m**
    - Opening pressure: 1.3 to 1.6 bar
11. **Connecting rod bolt, 30 N.m + 1/4 turn (90°) further**
    - Always replace
    - Oil threads and contact surface
    - To measure radial clearance use old bolts
    - To measure radial clearance tighten to 30 N.m but not further

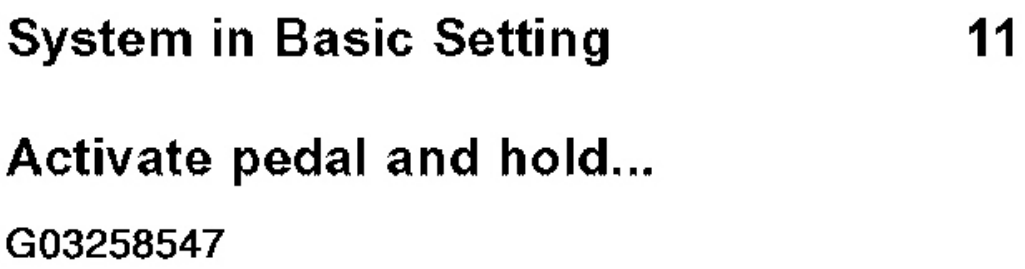

Fig. 72: Identifying Piston Components - Vehicles With Engine Code AWP, AWV
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Piston Ring Gap

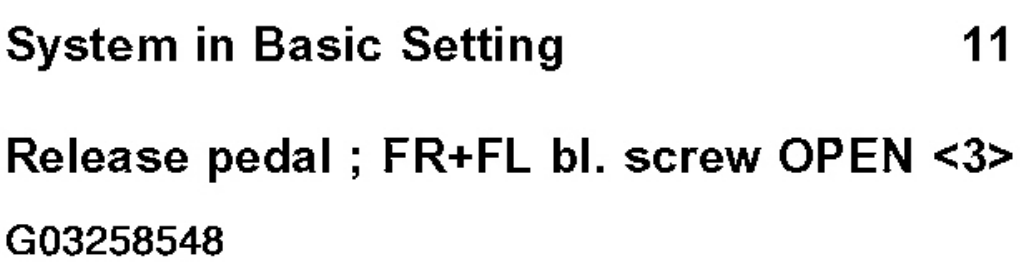

Fig. 73: Checking Piston Ring End Gap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Feeler gauges
- Push ring squarely from above down to approx. 15 mm from bottom end of cylinder.

PISTON RING END GAP (ENGINE CODE AWP, AWV)

Piston ring	Gap	
	New	Wear limit
Compression rings mm	0.20 to 0.40	0.8
Oil scraper ring mm	0.25 to 0.50	0.8

Checking Ring To Groove Clearance

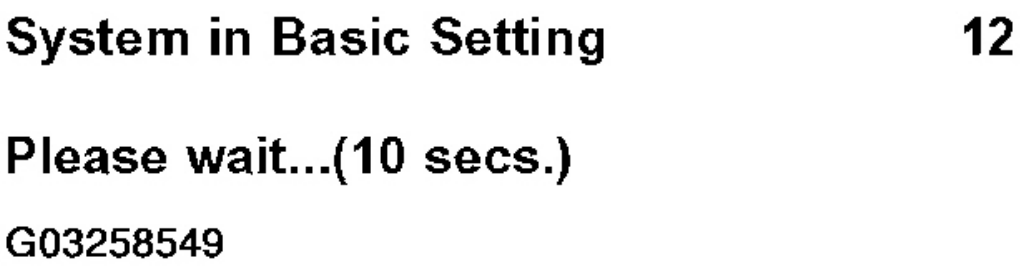

Fig. 74: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Feeler gauges

Clean groove before check.

PISTON RING CLEARANCE (ENGINE CODE AWP, AWV)

Piston ring	Clearance	
	New	Wear limit
Compression rings mm	0.06 to 0.09	0.20
Oil scraper ring mm	0.03 to 0.06	0.15

Checking Piston

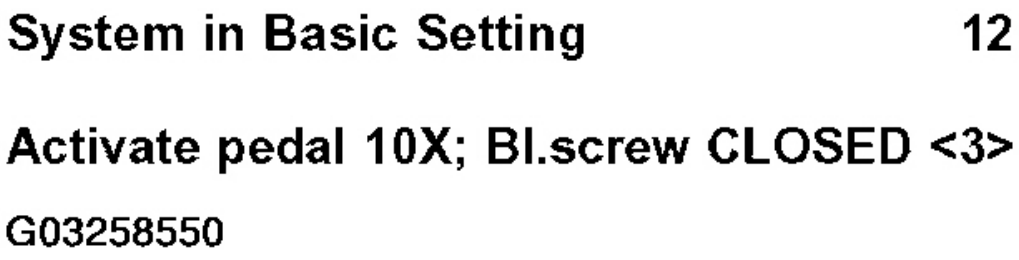

Fig. 75: Checking Piston Skirt Diameter (Engine Code AWP, AWV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Micrometer 75 to 100 mm
- Measure pistons approx. 10 mm from lower edge of skirt, at 90° to piston pin axis.

  Deviation from nominal dimension: max. 0.04 mm

Bearing Shells - Mount

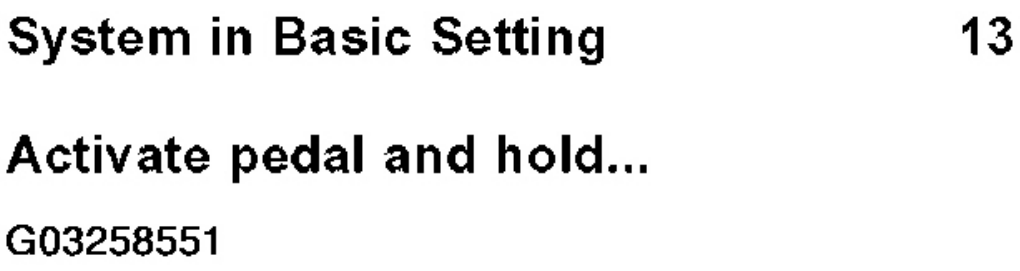

Fig. 76: Bearing Shells - Mounting In Connecting Rods
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Bearing shell -1- for connecting rod (with hole -arrow- for oil channel).

Bearing shell -2- for connecting rod (without hole for oil channel).

- Place bearing shells on the middle of connecting rod and connecting rod bearing cap.

  Measure -a- must be the same at right and left, max. deviation: 0.2 mm

Checking Cylinder Bores

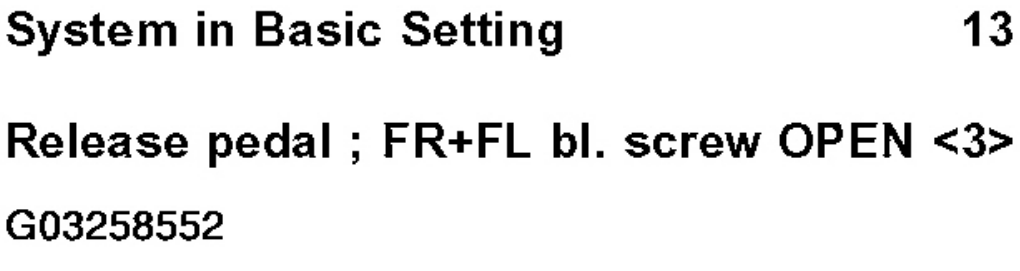

Fig. 77: Checking Cylinder Bores
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Internal dial gauge 50 to 100 mm

- Measure bores at 3 locations in both directions -A- across the engine and -B- in line with crankshaft.

  Deviation from nominal dimension: max. 0.08 mm

NOTE: Measuring the cylinder bores must not be done when the cylinder block is mounted on a repair stand with adapter bracket VW 540, as incorrect measurements would then be possible.

Piston and cylinder dimensions (engine codes: AWP, AWV)

PISTON AND CYLINDER DIMENSIONS (ENGINE CODES: AWP, AWV)

Honing dimension	Piston diameter	Cylinder bore diameter
Basic dimen. mm	80.965 (1)	81.01
1st oversize mm	81.465 (1)	81.51
(1) Dimension without graphite coating (thickness 0.02 mm). The graphite coating wears away.		

ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD, REMOVING AND INSTALLING

Checking compression. See **COMPRESSION PRESSURES, CHECKING** .

NOTE:

- **When installing an replacement cylinder head with installed camshaft, the contact surfaces between the hydraulic lifters and the cam must be oiled before installing the cylinder head cover.**
- **The plastic packing pieces for protecting the open valves must not be removed until immediately before installing cylinder head.**
- **If the cylinder head is replaced, all the coolant in the system must also be replaced.**
- **Removing and installing intake manifold:**

  For engine code APH, see FUEL INJECTION SYSTEM COMPONENTS, REMOVING AND INSTALLING . For engine codes AWP and AWV, see FUEL INJECTION SYSTEM COMPONENTS, REMOVING AND INSTALLING .

Cylinder head overview

NOTE: The following list refers to items in Fig. 78 .

1. **Cap**
   - Replace seal if damaged
2. **10 N.m**

3. **Cylinder head cover**
4. **Cylinder head cover gasket**
    - Replace if damaged
    - Before installing, coat transition from bearing cap e.g. camshaft adjuster/chain tightener to cylinder head with D 454 300 A2. See **Sealing transition points between double bearing cap and cylinder head** and **Sealing transition points between chain tensioner/cylinder head** .
5. **Oil deflector**
    - Note installation position: above intake camshaft
6. **Cylinder head**
    - Check for distortion. See **Reworking Cylinder Head Sealing Surface**
    - Reworking sealing surface. See **Reworking Cylinder Head Sealing Surface** .
    - Removing and installing. See **CYLINDER HEAD, REMOVING AND INSTALLING** .
    - After replacing completely replace coolant
7. **Intake manifold gasket**
    - Always replace
    - Note installation position
8. **Cylinder head gasket**
    - Always replace
    - Metal gasket
    - If replaced completely replace coolant
    - Note installation position: Identification: Part No. must be readable from intake side
9. **Toothed (Timing) belt**
    - Mark direction of rotation before removing
    - Check for wear
    - Do not kink
    - Removing, installing and tensioning. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .
10. **Exhaust manifold gasket**
    - Always replace
    - Note installation position
11. **Cylinder head bolt**
    - Always replace
    - Removing and installing Polydrive cylinder head bolt with 3452
    - Sequence when loosening and tightening. See **CYLINDER HEAD, REMOVING AND INSTALLING** .
12. **Gasket**
    - Replace if damaged

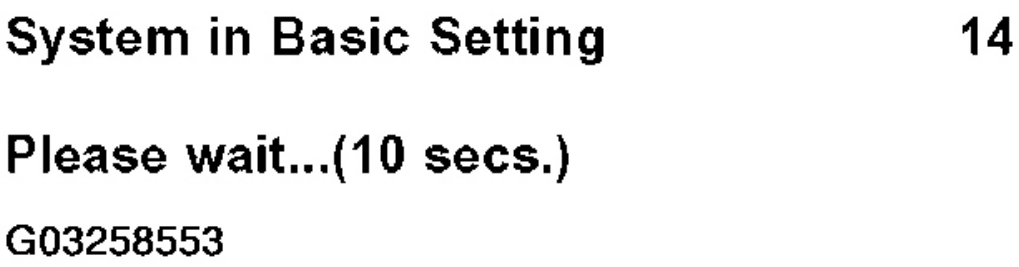

Fig. 78: Exploded View Of Cylinder Head Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Cylinder Head For Distortion

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

- Straight edge
- Feeler gauges

Max. permissible distortion: 0.1 mm

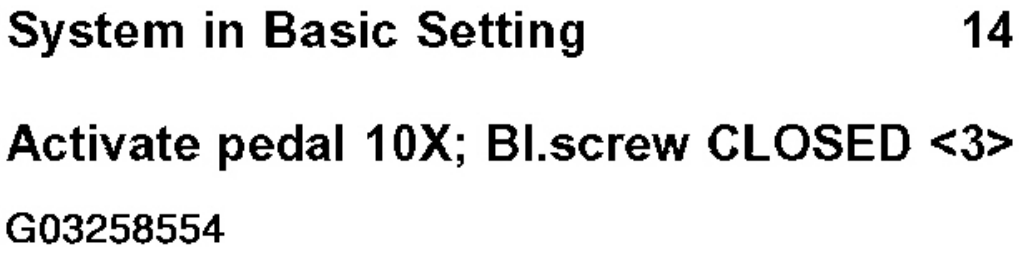

Fig. 79: Checking Cylinder Head For Distortion
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Cylinder head, removing and installing

Special tools and equipment

- VAG 1306 Drip tray

- VAG 1332 Torque wrench (40-200 N.m)
- VAG 1921 Hose clip pliers
- 3070 Installation tool with guide pins
- VAS 5024 Assembly tool for spring-type clamps

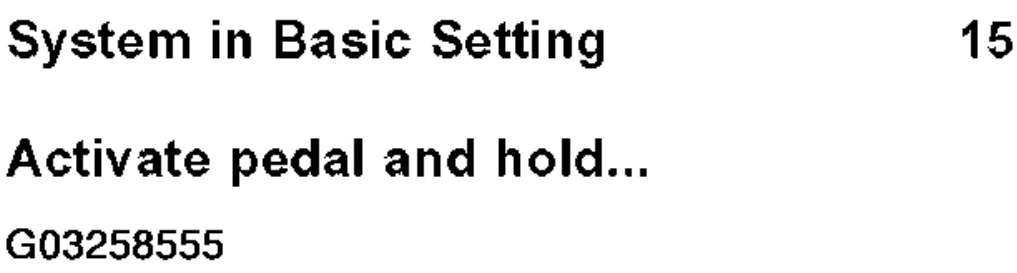

Fig. 80: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engines with Polydrive cylinder head bolts:

- 3452 Tool

Requirements

- The engine must be no more than warm to touch

Work sequence

- Note safety precautions before starting work. See **SAFETY PRECAUTIONS WHEN WORKING ON FUEL SUPPLY** .
- Observe rules for cleanliness. See **RULES OF CLEANLINESS** .
- Check whether a coded radio is installed. If so, obtain anti-theft coding.
- With ignition switched off, disconnect battery Ground strap.
- Remove engine cover.
- Drain coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .
- Remove secondary air pump motor and bracket.

WARNING: Fuel supply lines are under pressure! Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

- Separate fuel supply as well as fuel return pipes at connection on fuel rail. Fuel system is under pressure, therefore place a cloth over connection before hoses are pulled off.
- Seal lines so that fuel system is not contaminated by dirt etc.
- Remove coolant hose connections on cylinder head.
- Remove inter-connecting, coolant, vacuum and intake hoses on engine.
- Pull connector(s) off ignition coils.
- Pull off/disconnect all other electrical connections as necessary from engine and lay to one side.
- Remove intake air hose from connection of exhaust turbocharger as follows:
- Pull off hose at pressure regulator valve of crankshaft ventilation.
- Disconnect harness connector at Wastegate Bypass Regulator Valve -N75-.
- Pull off hose at Wastegate Bypass Regulator Valve -N75-.
- Disconnect hose from solenoid valve to turbocharger at bulkhead.
- Disconnect hose between EVAP canister and exhaust turbocharger at bulkhead.
- Pull out securing buckle at connector of exhaust turbocharger and remove air intake hose.
- Remove heat protection pad 1 from air guiding hose 2 (observe installation position).

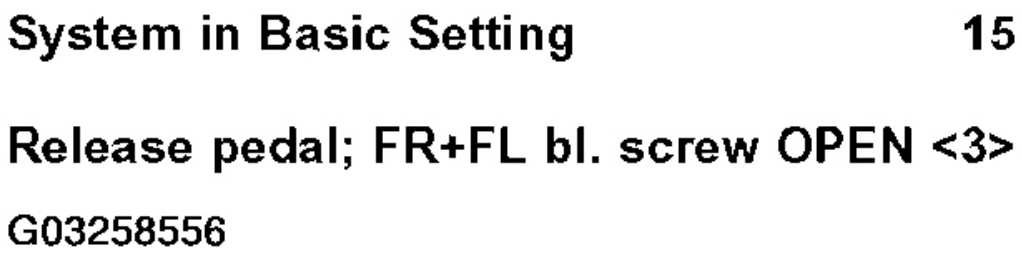

Fig. 81: Removing Heat Protection Pad 1 From Air Guiding Hose 2
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove air guiding hose 2.
- Loosen 2 bolts from bracket of upper air guiding hose. See **ONLY FOR ENGINE CODE APH** , Item 8
- Remove heat protection pad from air guiding hose (observe installation position) and loosen clamp 3.

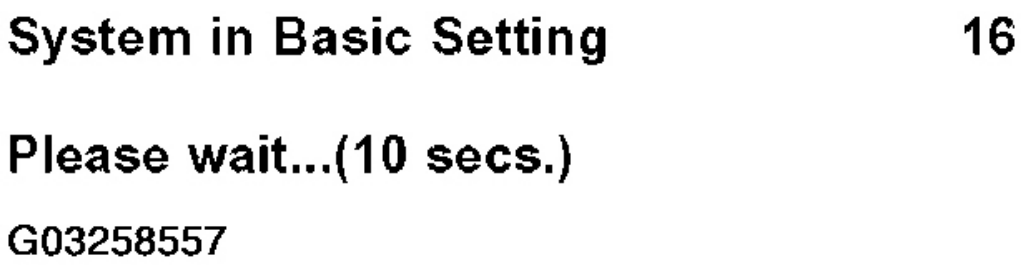

Fig. 82: Removing Heat Protection Pad From Air Guiding Hose And Loosening Clamp 3
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove screws 1 and 4 for heat shield from behind cylinder head.
- Loosen screws 2 and 5.
- Remove air guiding hose, hose to turbocharger and heatshield.
- Remove three exhaust gas turbocharger/exhaust manifold securing bolts -arrows-.

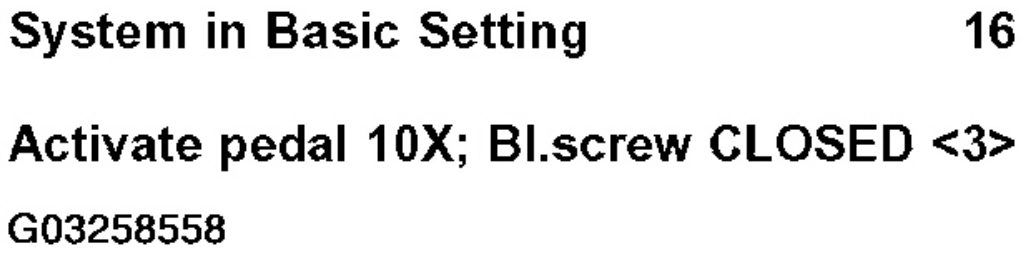

Fig. 83: Removing Three Exhaust Gas Turbocharger/Exhaust Manifold Securing Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove tensioning element for ribbed belt.
- Remove toothed belt guard (upper part).
- Set camshaft sprocket to TDC No. 1 cylinder by turning crankshaft. Mark on camshaft sprocket must align with arrow on toothed belt guard.

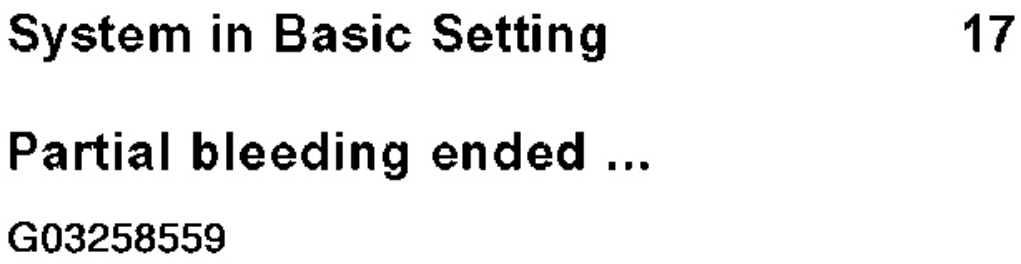

Fig. 84: Aligning Mark On Camshaft Sprocket With Arrow On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Mark direction of rotation of toothed belt.
- Remove toothed belt and toothed belt tensioner. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .
- Turn crankshaft back slightly.
- Loosen pressure piston again and remove threaded pin.
- Remove ignition coils.
- Remove cylinder head cover.
- Loosen socket head bolts in sequence given and then remove completely.

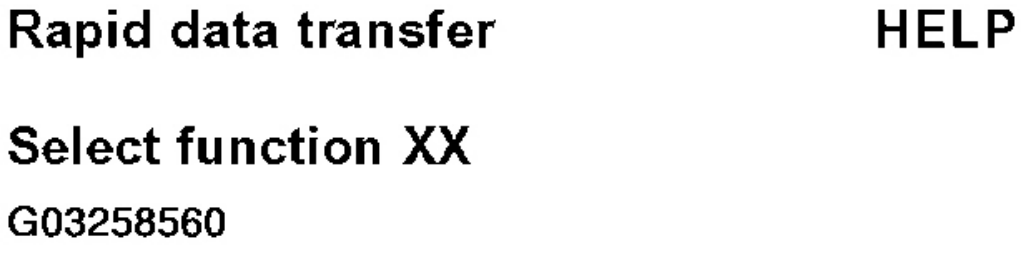

Fig. 85: Loosening Socket Head Bolts In Sequence
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Use tool 3452 for Polydrive cylinder head bolts.

- Carefully lift cylinder head off.

Installing

NOTE:

- **There must be no oil or coolant in the cylinder head bolt pockets in the cylinder head.**
- **Only remove the new cylinder head gasket from its packing immediately before installing.**
- **Handle the new gasket with extreme care. Damaging will lead to leaks.**

- Place a clean cloth in cylinders so that no dirt or emery cloth particles can get in between cylinder wall and piston. Also prevent dirt and emery cloth particles from getting into coolant
- Carefully clean cylinder head and cylinder block sealing surfaces. Ensure that no scoring or scratches are formed (when using abrasive paper the grade must not be less than 100).
- Carefully remove metal particles, emery remains and cloths.
- Turn crankshaft to TDC No. 1 cylinder.

Fig. 86: Turning Crankshaft To TDC Of No. 1 Cylinder
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft back slightly.
- Loosen bolts 1 and 2 at bracket for turbocharger approx. 2 revolutions in order to avoid tension when installing cylinder head.

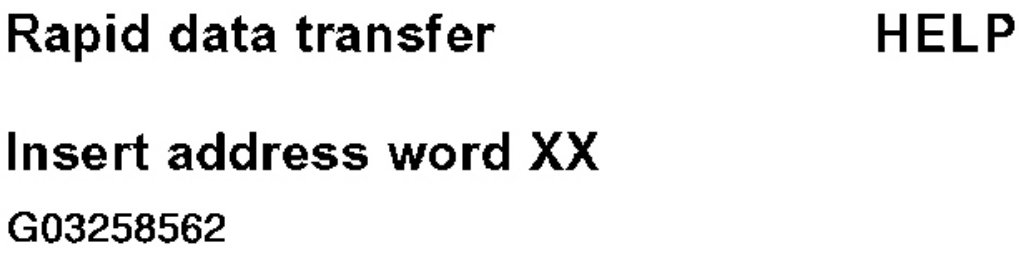

Fig. 87: Loosening Bolts 1 And 2 At Bracket For Turbocharger
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Center screw guide pins from 3070 into holes for cylinder head bolts 8 and 10.

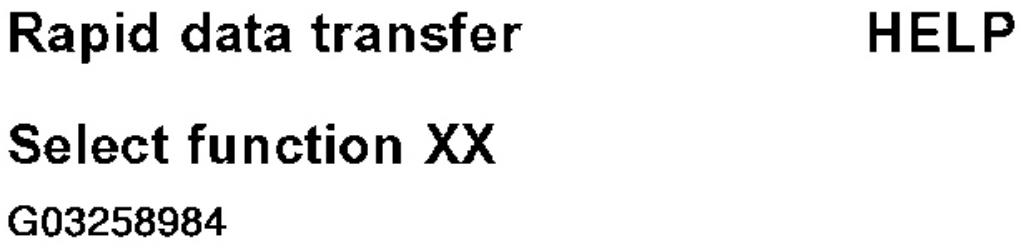

Fig. 88: Installing Cylinder Head Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install new cylinder head gasket. Lettering (Part No.) must be readable.
- Install cylinder head, screw in 8 remaining cylinder head bolts and tighten by hand.
- Remove guide pins with removal tool from 3070. To do this turn removal tool counterclockwise, until pins are free.
- Install remaining cylinder head bolts and tighten hand-tight.
- Tighten cylinder head in tightening sequence as follows:

Rapid data transfer Q

03-Final control diagnosis

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Fig. 89: Cylinder Head Bolt Tightening Sequence
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pretighten all bolts to 40 N.m.
- Then tighten all bolts 1/4 turn (90°) further using a rigid wrench.
- Then tighten all bolts again 1/4 turn (90°) further.

NOTE: There is no requirement to retighten the cylinder head bolts after repairs.

- Install gasket between turbocharger/exhaust manifold and bolt turbocharger as well as bracket to cylinder head.
- Install toothed belt and adjust valve timing. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .

Filling with new coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .

The rest of the assembly is basically a reverse of the disassembling sequence.

- Perform work sequence "Procedure after voltage supply open circuit".

  For engine code APH see **PROCEDURE AFTER CORRECTING VOLTAGE SUPPLY OPEN CIRCUIT** . For engine codes AWP and AWV, see **PROCEDURE AFTER CORRECTING VOLTAGE SUPPLY OPEN CIRCUIT** .

- Check DTC memory.

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

- Read readiness code.

  See **READINESS CODE** .

- Match engine electronics control module to throttle valve control module.

  For engine code APH, see **ENGINE CONTROL MODULE (ECM) TO THROTTLE VALVE CONTROL MODULE, ADAPTING** . For engine codes AWP and AWV, see **MOTRONIC ENGINE CONTROL MODULE (ECM) - J220- TO THROTTLE VALVE CONTROL MODULE - J338-, ADAPTING** .

  If the DTC memory has been erased or the Engine Control Module separated from permanent (battery) positive, the readiness code must be generated again.

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

Compression pressures, checking

Special tools and equipment

- 3122 B Spark plug removal tool
- VAG 1331 Torque wrench (5-50 N.m)
- VAG 1763 Compression tester

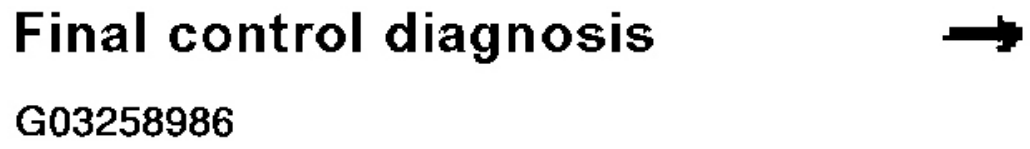

Fig. 90: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirements

- Remove fuse 32.

  NOTE: Removing fuse 32 interrupts the voltage supply to the injectors. Fuse block is behind access panel at far left end of dash.

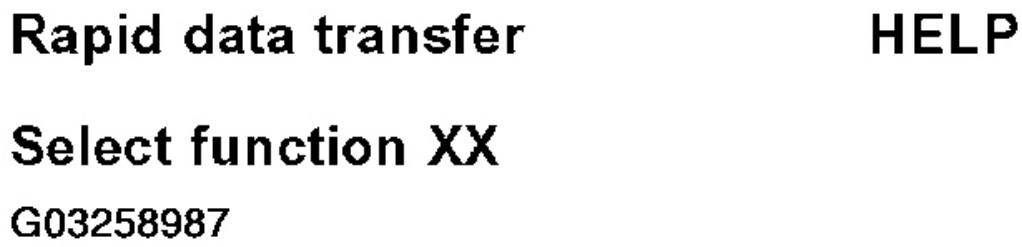

Fig. 91: Removing Fuse 32
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Test conditions

- Engine oil temperature must be at least 30 °C.

Work sequence

- Remove engine cover.
- Pull connector(s) off ignition coils.
- Remove ignition coils.
- Remove spark plugs with spark plug removal tool 3122B.
- Fully open throttle valve.

NOTE: Using the compression tester. See Operating instructions.

- Check compressions with compression tester VAG 1381 / VAG 1763.
- Operate starter until tester shows no further pressure increase.

Compression pressure:

- New: 10-14 bar
- Wear limit: 7.0 bar
- Permissible difference between all cylinders: 3 bar
    - Thread in spark plugs with spark plug socket and extension 3122B and tighten to 30 N.m.

Vehicles with engine code: APH

- Install ignition coils and tighten to 10 N.m.

Vehicles with engine codes: AWP, AWV

- Install ignition coils. During this, make sure ignition coils are securely seated.

Continued for all vehicles

- Check DTC memory.

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

- Read readiness code.

  See **READINESS CODE** .

  If the DTC memory has been erased or the Engine Control Module separated from permanent (battery) positive, the readiness code must be generated again.

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

VALVE GEAR, SERVICING

NOTE:

- **Cylinder heads which have cracks between the valve seats or between valve seat inserts and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first four spark plug threads are cracked.**
- **After installing new hydraulic lifters, the engine must not be started for approx. 30 minutes (otherwise valves will strike pistons), then turn crankshaft two rotations.**

NOTE: The following list refers to items in Fig. 92 .

1. **10 N.m**
2. **Intake camshaft**
   - Checking axial clearance. See **Checking Camshaft Axial Clearance**
   - Removing and installing. See **VALVE GEAR, SERVICING**

     Checking radial clearance with plastigage:

   - Wear limit: 0.1 mm
   - Run-out: max. 0.01 mm
3. **Drive chain**
   - Before removing mark direction of rotation (installation position). See **CAMSHAFT, REMOVING AND INSTALLING** .

4. **10 N.m**
5. **O-ring**
    - Always replace
    - Only for engine codes: AWP, AWV
6. **Camshaft adjustment valve (N205)**
    - Only for engine codes: AWP, AWV
    - Check camshaft adjustment. See **CAMSHAFT ADJUSTMENT, CHECKING** .
7. **3 N.m**
    - Only for engine codes: AWP, AWV
8. **Camshaft adjuster**
    - Only for engine codes: AWP, AWV
    - For vehicles with engine code: APH; Chain tensioner
    - Secure with 3366 before removing. See **CAMSHAFT, REMOVING AND INSTALLING** .
        - Seal transition of hydraulic chain tensioner/cylinder head. See **Sealing transition points between chain tensioner/cylinder head**
    - Check camshaft adjustment. See **CAMSHAFT ADJUSTMENT, CHECKING** .
9. **Gasket**
    - Rubber/metal seal
    - Replace
10. **Cylinder head**
    - Removing and installing. See **CYLINDER HEAD, REMOVING AND INSTALLING** .
    - Refacing valve seats. See **VALVE SEATS, REFACING** .
    - Reworking sealing surface. See **Reworking Cylinder Head Sealing Surface** .
    - Sealing transition points. See **Sealing transition points between double bearing cap and cylinder head** and **Sealing transition points between chain tensioner/cylinder head** .
11. **Valves**
    - Do not rework only grinding-in is permitted
    - Valve dimensions. See **Valve Dimensions** .
    - Sodium-filled exhaust valves: Observe disposal instructions. See **VALVE SEATS, REFACING**
12. **Oil seal**
    - Replacing. See **CAMSHAFT OIL SEAL, REPLACING** .
13. **Hood**
    - For Camshaft Position (CMP) sensor
    - When installing note fixing arrangement
14. **Washer**
    - Conical
15. **25 N.m**
16. **Camshaft Position (CMP) sensor -G40-**

See **CHECK CAMSHAFT POSITION (CMP) SENSOR** .

17. **10 N.m**
18. **65 N.m**
    - Use counter-hold 3036 to loosen and tighten
19. **Camshaft sprocket**
    - Note installation position: small web of camshaft sprocket points outward and No. 1 Cyl. TDC marking is visible
    - Note position when installing toothed belt. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .
20. **Oil seal**
    - Replacing. See **CAMSHAFT OIL SEAL, REPLACING** .
21. **Valve guide**
    - Checking. See **VALVE GUIDES, CHECKING** .
22. **Valve stem seal**
    - Replacing. See **VALVE STEM SEALS, REPLACING** .
23. **Valve spring**
    - Removing and installing: remove cylinder head with 3362
    - Installing. See **VALVE STEM SEALS, REPLACING** .
24. **Upper valve spring plate**
25. **Valve keepers**
26. **Hydraulic lifter**
    - Do not interchange
    - With hydraulic valve clearance compensation
    - Checking. See **HYDRAULIC LIFTERS, CHECKING**
    - Store with cam contact surface downward
    - Before installing check camshaft axial clearance. See **Checking Camshaft Axial Clearance** .
    - Oil contact surface
27. **Intake camshaft bearing cap**
    - Installation position and installation sequence. See **CAMSHAFT, REMOVING AND INSTALLING** .
28. **Double bearing cap**
    - Lightly coat bearing cap contact surface with sealant AMV 174 004 01
    - Must sit on alignment bushing
    - Seal transitions of double-bearing cap/cylinder head. See **Sealing transition points between double bearing cap and cylinder head** .
29. **Exhaust camshaft bearing cap**
    - Installation position and installation sequence. See **CAMSHAFT, REMOVING AND INSTALLING** .

30. **Exhaust camshaft**
    - Checking axial clearance. See **Checking Camshaft Axial Clearance**
    - Removing and installing. See **CAMSHAFT, REMOVING AND INSTALLING** .

    Checking radial clearance with plastigage:

    - Wear limit: 0.1 mm
    - Run-out: max.: 0.01 mm

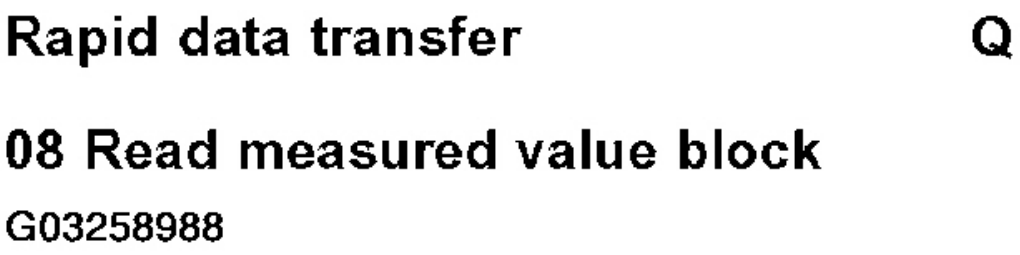

Fig. 92: Exploded View Of Valve Train Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Reworking Cylinder Head Sealing Surface

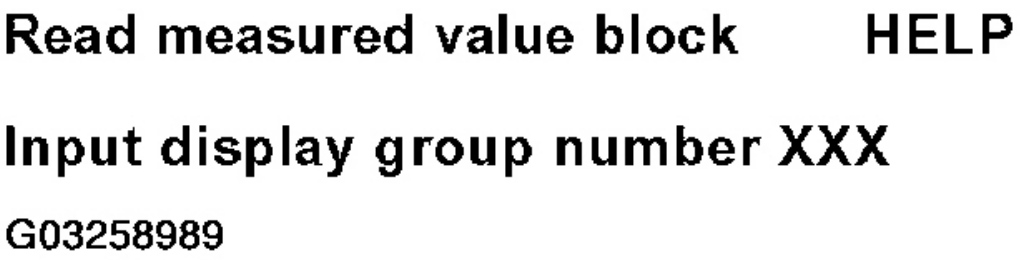

Fig. 93: Measuring Point For Reworking Cylinder Head Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

The dimension for reworking is measured through the holes for the cylinder head bolts.

-a- = minimum 139.2 mm

Checking Camshaft Axial Clearance

Special tools and equipment

- Universal dial indicator bracket VW 387
- Dial indicator

Check with hydraulic lifters and chain removed and No. 2 and 4 bearing caps installed.

Wear limit: max. 0.2 mm

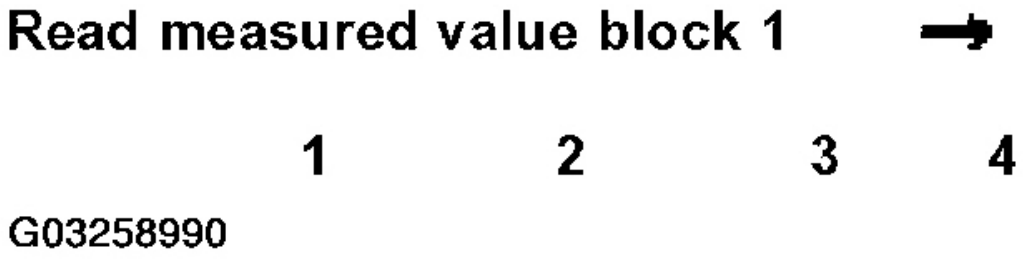

Fig. 94: Checking Camshaft Axial Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Valve Dimensions

NOTE: Valves must not be reworked. Only lapping-in is permitted.

NOTE: The following table refers to items in Fig. 95 .

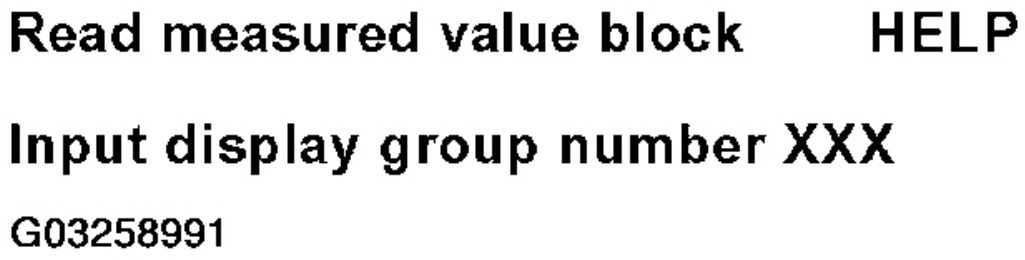

Fig. 95: Valve Dimensions
Courtesy of VOLKSWAGEN OF AMERICA, INC.

VALVE DIMENSIONS

Dimension	Intake valve	Exhaust valve
dia. a (mm)	26.9	29.9
dia. b (mm)	5.963	5.943
c (mm)	104.84 - 105.34	103.64 - 104.14
Angle a (angle °)	45	45

NOTE: Care must be taken when disposing of old sodium filled valves. They must be cut through in the center of the stem with a hacksaw. When doing this they must be perfectly dry. The valves prepared in this way can then be thrown into a bucket of water a maximum of ten at a time. When doing this step back quickly because a sudden chemical reaction causes the sodium filling to burn. After this treatment, the valves can be put in with the normal scrap.

Sealing transition points between double bearing cap and cylinder head

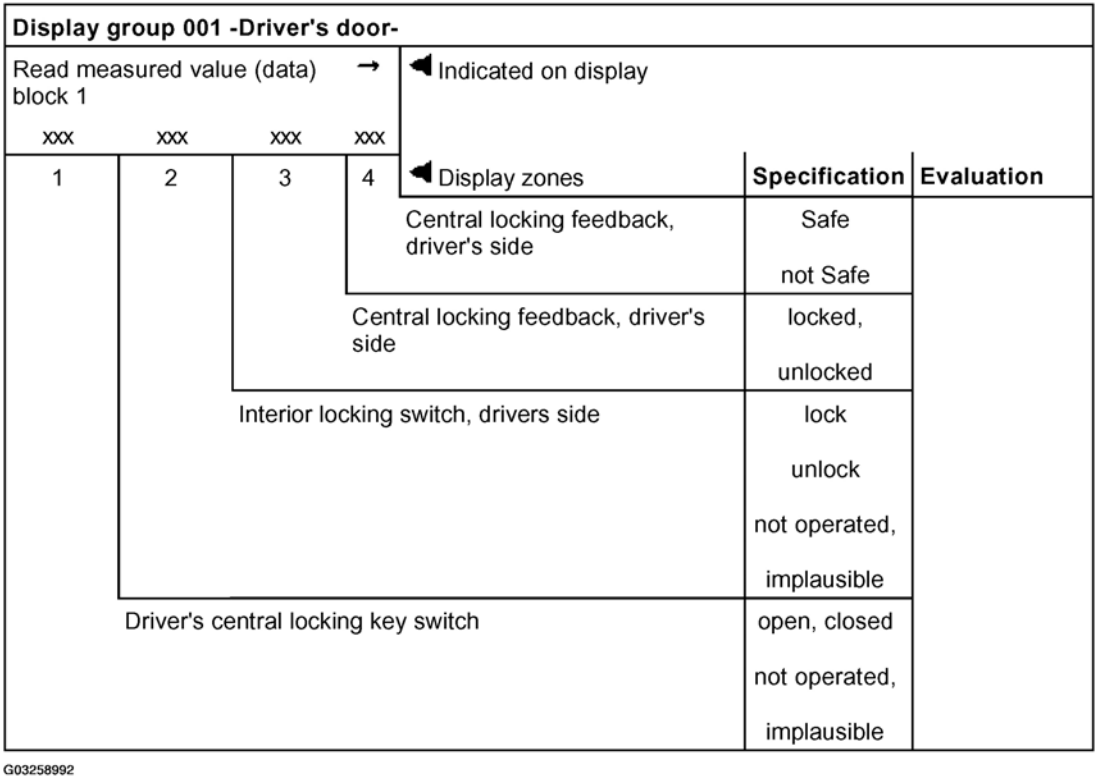

Fig. 96: Identifying Sealing Transition Points Between Double Bearing Cap And Cylinder Head
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully apply a thin coat of sealant D 454 300 A2 to both edges of sealing surfaces between double bearing cap and cylinder head -arrows- using a small screwdriver.

Sealing transition points between chain tensioner/cylinder head

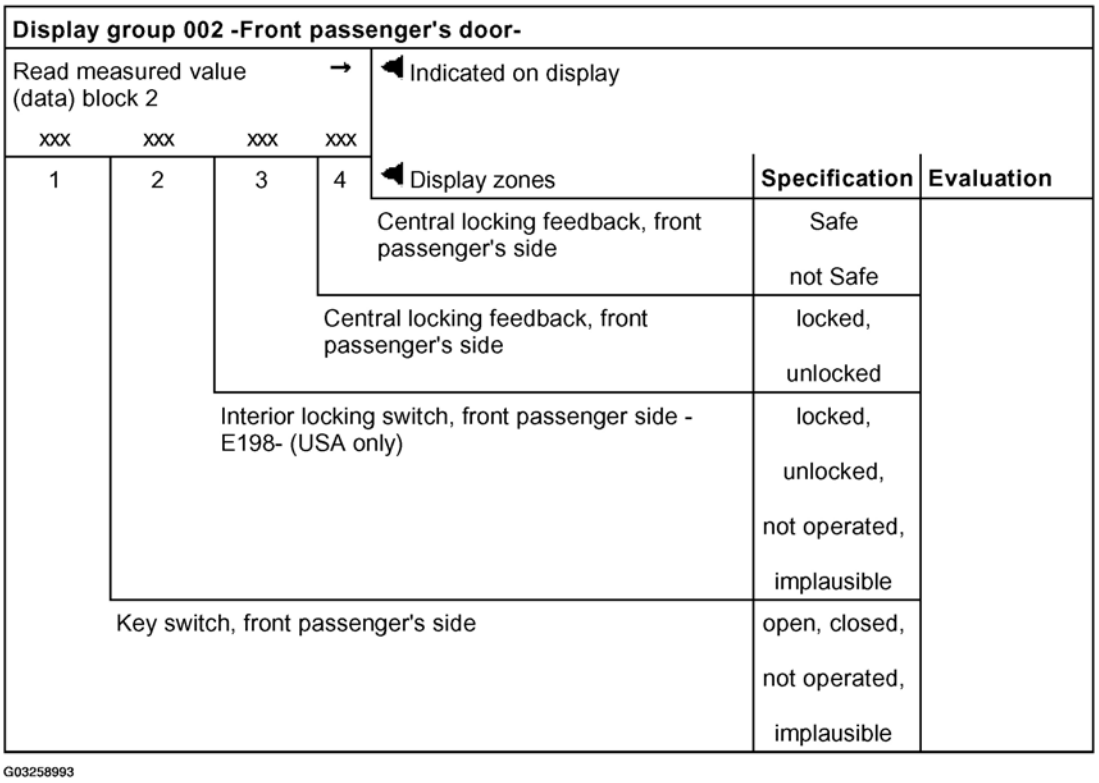

Fig. 97: Identifying Sealing Transition Points Between Chain Tensioner/Cylinder Head
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully apply a thin coat of sealant "D 454 300 A2" to both edges of sealing surfaces between camshaft adjuster and cylinder head -arrows- using a small screwdriver.

Valve seats, refacing

Special tools and equipment

- Depth gauge
- Valve seat refacing tool

NOTE:

- **When repairing engines with leaking valves, it is not sufficient to replace or replace valve seats and valves. It is also necessary to check the valve guides for wear. This particularly important on high mileage engines. See VALVE GUIDES, CHECKING .**
- **The valve seats should only be reworked just enough to produce a perfect seating pattern. The maximum permissible reworking dimension must be calculated before reworking commences. If the reworking dimension is exceeded, the function of the hydraulic lifters can no longer be guaranteed and the cylinder head should be replaced.**

The max. permissible reworking dimension is calculated as follows:

- Insert valve and press firmly against seat.

  NOTE: If the valve is to be replaced as part of a repair, use a new valve for the calculation.

- Measure distance between end of valve stem and upper edge of cylinder head.

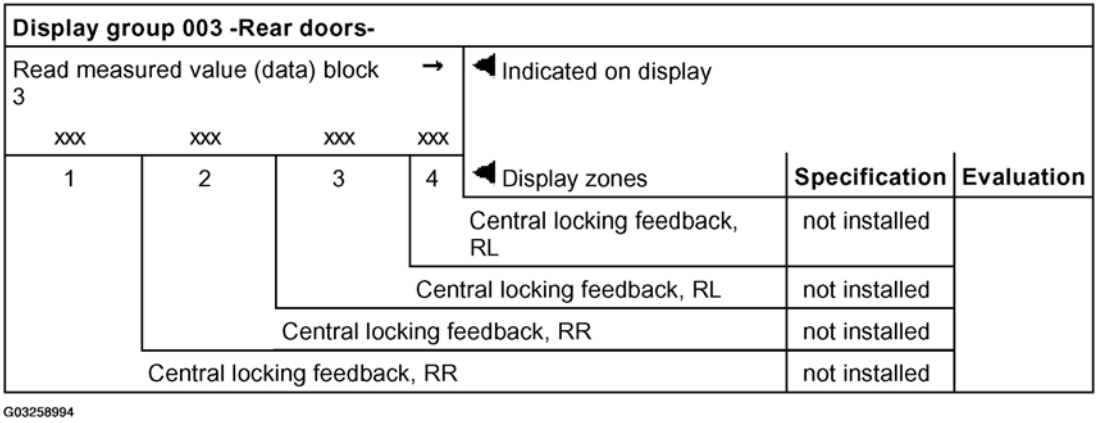

Fig. 98: Measuring Distance Between End Of Valve Stem And Upper Edge Of Cylinder Head
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Calculate max. permissible reworking dimension from measured distance and minimum dimension.

  Minimum dimension:

  Outer intake valves: 34.0 mm

  Center intake valve: 33.7 mm

Exhaust valve: 34.4 mm

Measured distance minus minimum dimension = max. permissible reworking dimension.

Example:

CALCULATING PERMISSIBLE REWORKING DIMENSION

Measured distance	34.4 mm
- Minimum dimension	34.0 mm
= max. perm. rework dimension (1)	0.4 mm
(1) The max. permissible reworking dimension is shown on illustrations for refacing valve seats as	

dimension "b."

Reworking intake valve seat

Display group 004 -Central control unit-						
Read measured value (data) block 4 →				◀ Indicated on display		
xxx	xxx	xxx				
1	2	3	4	◀ Display zones	Specification	Evaluation
				Empty[1)]		
				Rotary latch switch, rear	not installed	
				Rotary latch switch, front passenger's side	door open, door closed	
				Rotary latch switch, driver's side	door open, door closed	

[1)] Empty means in this case: Display zone is blank

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Fig. 99: Reworking Valve Seat Dimensions
Courtesy of VOLKSWAGEN OF AMERICA, INC.

a = 26.2 mm diameter

b = Max. permissible reworking dimension

NOTE: Calculating max. permissible reworking dimension. See VALVE SEATS, REFACING .

c = 1.5- 1.8 mm

Z = Cylinder head lower edge

"ALPHA" = 45° valve seat angle

"BETA" = 30° upper correction angle

"GAMMA" = 60° lower correction angle

Reworking exhaust valve seat

a = 29.0 mm diameter

b = Max. permissible reworking dimension

NOTE: Calculating max. permissible reworking dimension. See VALVE SEATS, REFACING .

c = Approx. 1.8 mm

Z = Cylinder head lower edge

"ALPHA" = 45° valve seat angle

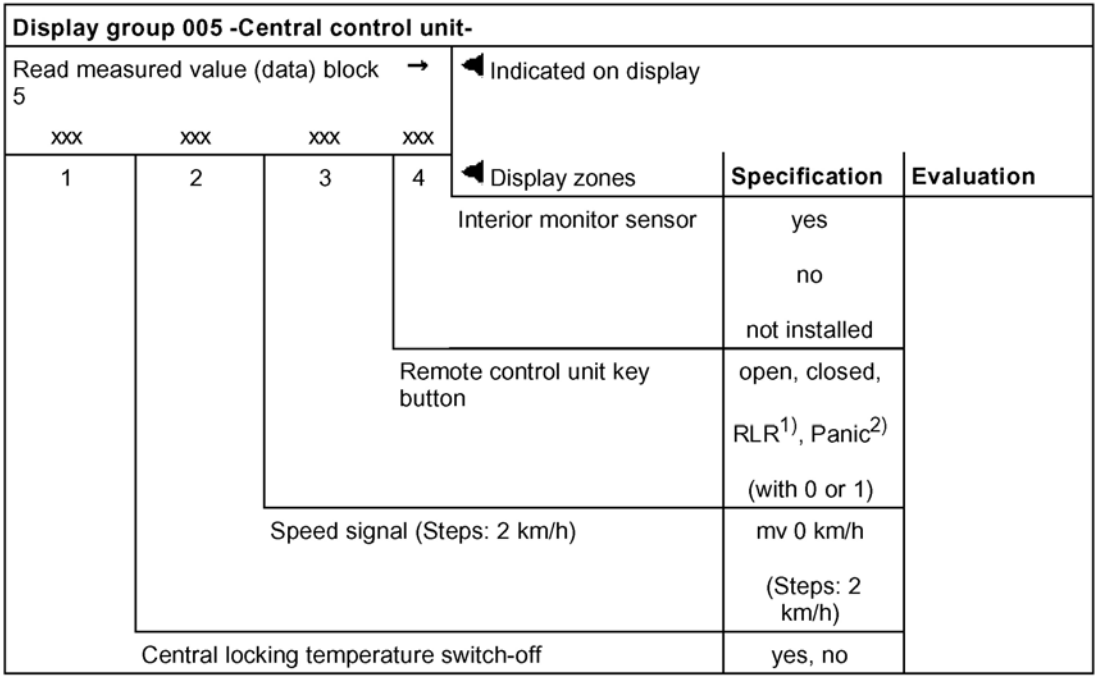
"BETA" = 30° upper correction angle

"GAMMA" = 60° lower correction angle

Camshaft oil seal, replacing

Special tools and equipment

- VAG1331 Torque wrench (5-50 N.m)
- VAG1332 Torque wrench (40-200 N.m)
- 3036 Counter hold tool
- 3241 Fitting sleeves
- 2085 Oil seal extractor



Display group 005 -Central control unit-						
Read measured value (data) block → 5				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Interior monitor sensor	yes no not installed	
				Remote control unit key button	open, closed, RLR[1], Panic[2] (with 0 or 1)	
				Speed signal (Steps: 2 km/h)	mv 0 km/h (Steps: 2 km/h)	
				Central locking temperature switch-off	yes, no	

[1] Only vehicles for USA, RLR= Rear lid Remote release

[2] Only vehicles for USA, alarm system and turn signal lights are activated

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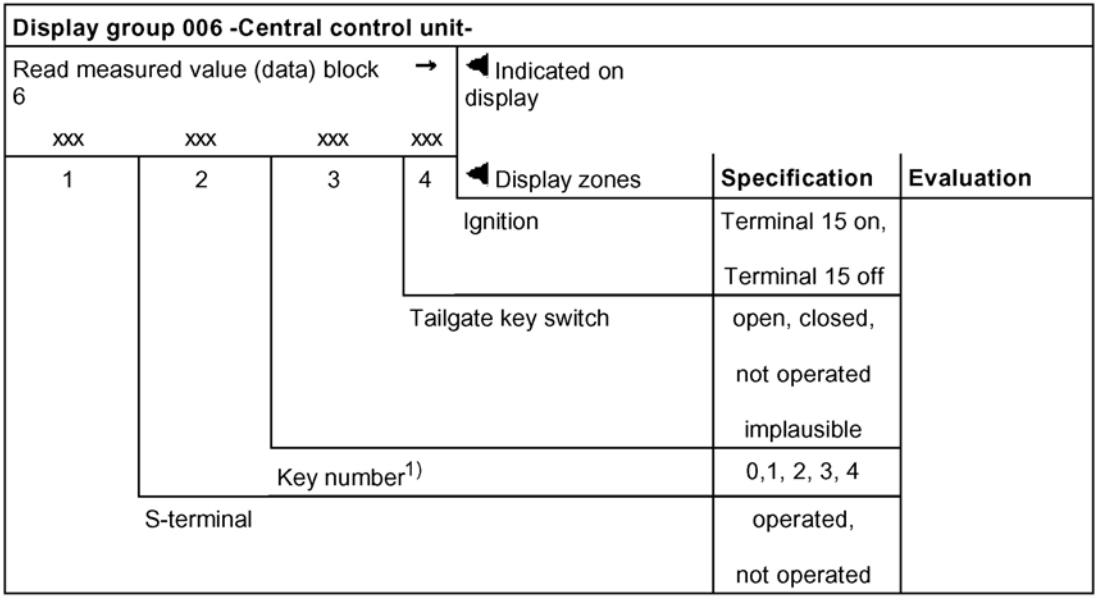
Fig. 100: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing oil seal on camshaft sprocket

- Remove seal on Camshaft Position (CMP) sensor. See **OIL SEAL ON CAMSHAFT POSITION (CMP) SENSOR, REMOVING** .
- Remove toothed belt guard (upper part).
- Set camshaft sprocket to TDC No. 1 cylinder by turning crankshaft. Mark on camshaft sprocket must align with mark on cylinder head cover.



Display group 006 -Central control unit-						
Read measured value (data) block 6 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Ignition	Terminal 15 on, Terminal 15 off	
				Tailgate key switch	open, closed, not operated implausible	
				Key number[1)]	0,1, 2, 3, 4	
				S-terminal	operated, not operated	

[1)] Display 1 for remote control key 1 is performed by operating a button on remote control key

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Fig. 101: Aligning Mark On Camshaft Sprocket With Mark On Cylinder Head Cover
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove cylinder head cover.
- Release tensioner and remove toothed belt from camshaft sprocket.
- Turn crankshaft back slightly.
- Remove camshaft sprocket. When loosening camshaft sprocket bolt counter-hold with 3036.
- Remove woodruff key from camshaft.
- Screw camshaft sprocket securing bolt -arrow- into camshaft onto stop by hand, to guide seal extractor.

Display group 007 -Central control unit-						
Read measured value (data) block 7 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Sliding/tilting sunroof (STR) control	open, closed, not operated	
				Sliding/tilting sunroof (STR) authorized 1)	yes, no	
				Trunk lid/tailgate contact switch	open, closed	
				Hood contact switch	open, closed, not installed	

1) The control unit sends a "switch-off delay" terminal 15 to sliding/tilting sunroof. Therefore the operation of the sliding/tilting sunroof is still possible, after switching off the ignition, and until a door is opened.

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Fig. 102: Screwing Camshaft Sprocket Securing Bolt Into Camshaft Onto Stop
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unscrew inner part of oil seal extractor 2085 two turns (approx. 3 mm) out of outer part and lock in position with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.

Display group 008 -Central control unit-						
Read measured value (data) block 8 →				Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	Display zones	Specification	Evaluation
				Empty[1]		
				Interior monitoring switch-off[3]	on, off, not installed	
				Rear lid button and rear lid handle[2]	Not operated, RLR and RL handle, implausible	
				Vehicle system voltage terminal 30	Volts	

[1] Empty means in this case: Display zone is blank

[2] Rear lid remote unlocking button, rear lid handle

[3] Interior monitoring switch-off

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Fig. 103: Removing Oil Seal Using Special Tool 2085
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE: Gradual introduction of PTFE (Teflon) oil seal (identifying characteristics: no annular spring, sealing lip wider). The sealing lip of this oil ring must not be oiled or lubricated. A plain encased seal of older construction (with annular spring) may be replaced with a PTFE oil seal, but not vice versa.

- Before installing, remove oil remains from crankshaft journal with a clean cloth.
- Install guide sleeve 3241/2 onto camshaft journal.

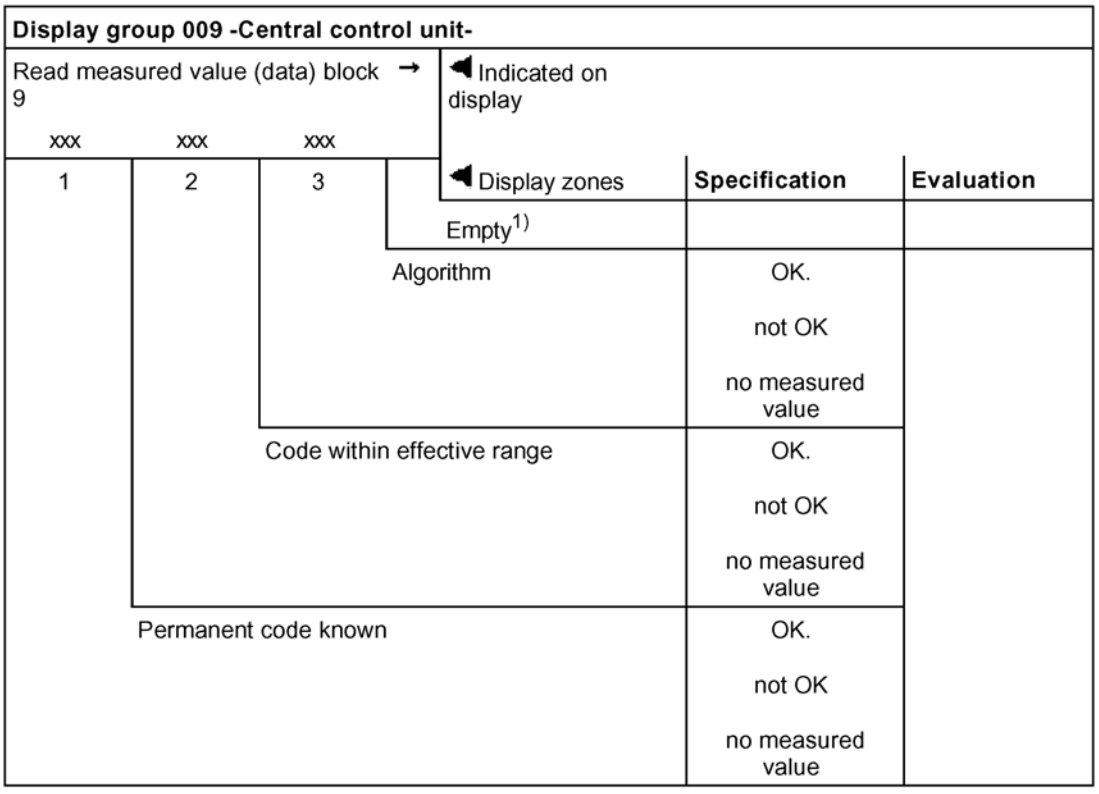

Fig. 104: Installing Guide Sleeve 3241/2 Onto Camshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve.
- Press seal in onto stop with press sleeve 3241/1 and bolt 3241/5.

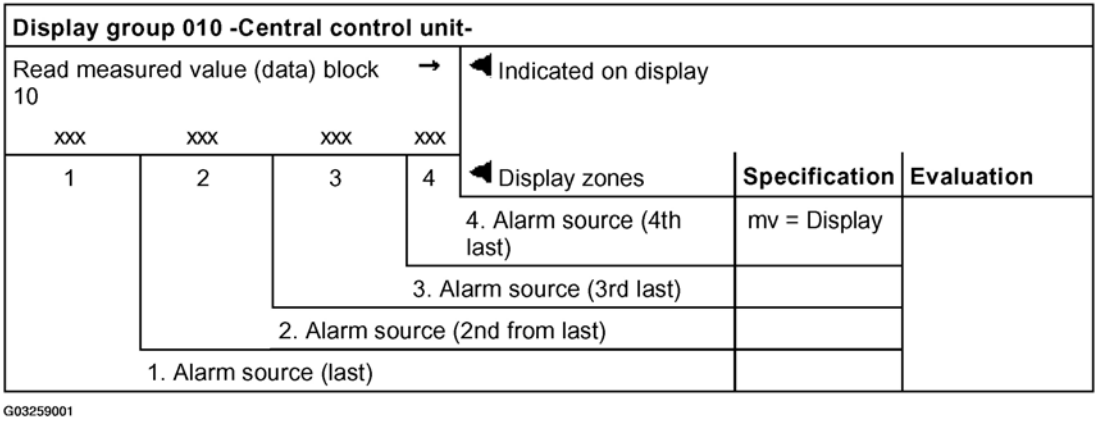

Fig. 105: Pressing Seal In Onto Stop With Press Sleeve 3241/1 And Bolt 3241/5

Courtesy of VOLKSWAGEN OF AMERICA, INC.

The rest of the assembly is basically a reverse of the disassembling sequence.

Installing toothed belt and adjusting timing. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .

Oil seal on Camshaft Position (CMP) sensor, removing

Special tools and equipment

- 2085 Oil seal extractor
- 3241 Seal installer (for seal in standard version with annular spring)
- T10071 Puller (for seal in PTFE-version)
- VAG1331 Torque wrench (5 to 50 N.m)
- VAG1332 Torque wrench (40 to 200 N.m)
- Bolt M8 X 60

Display group 011 -Central control unit-

Read measured value (data) block 11 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Empty[1)]		
				Rear lid prelock catch[2)]	open, closed, not installed	
				Automatic- lock / unlock- switch	Not relevant	
				Immobilizer key recognition	yes, no, not installed	

1) Empty means in this case: Display zone is blank

2) Rotary latch of lock must be detent in the first stage

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Fig. 106: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Pull connector off Camshaft Position (CMP) sensor -G40- -arrow-.

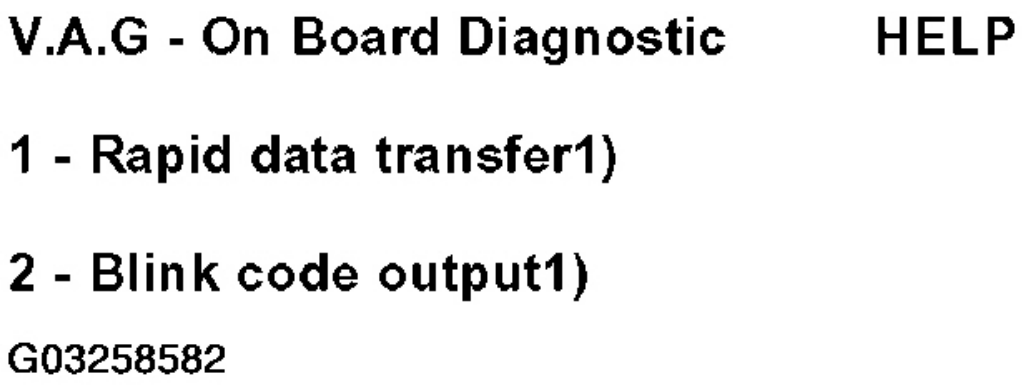

Fig. 107: Pulling Connector Off Camshaft Position Sensor G40
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove toothed belt guard (upper part).
- Remove housing for Camshaft Position (CMP) sensor.
- Remove washer and hood for Camshaft Position (CMP) sensor.
- Screw bolt 2085/1 into camshaft onto stop by hand, to guide seal extractor.

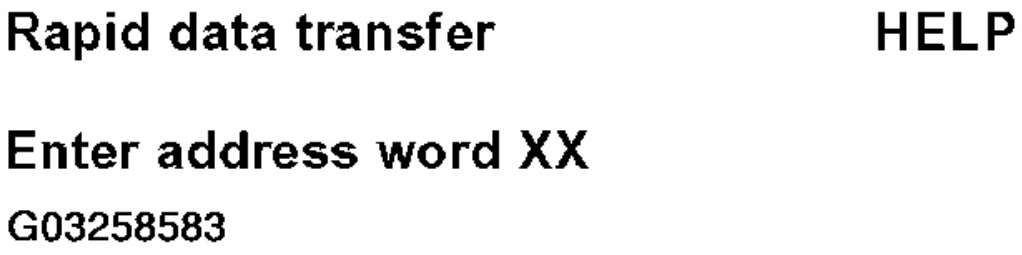

Fig. 108: Screwing Bolt 2085/1 Into Camshaft Onto Stop By Hand To Guiding Seal Extractor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unscrew inner part of oil seal extractor 2085 two turns (approx. 3 mm) out of outer part and lock in position with knurled screw.

- Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure screw it into oil seal as far as possible.

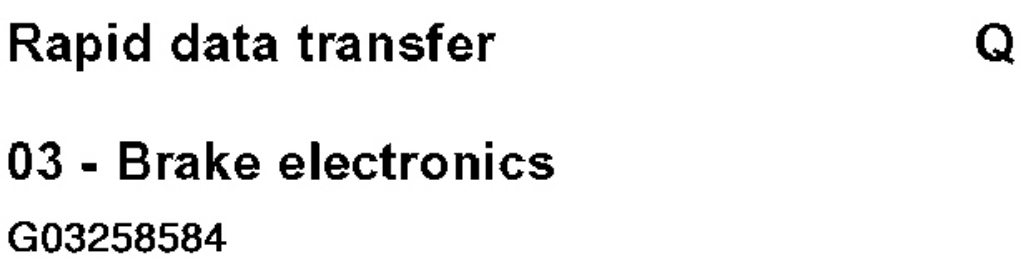

Fig. 109: Lubricating Threaded Head Of Oil Seal Extractor And Placing In Position
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.

Installing

NOTE: Gradual introduction of PTFE (Teflon) oil seal (identifying characteristics: no annular spring, sealing lip wider). The sealing lip of this oil ring must not be oiled or lubricated. A plain encased seal of older construction (with annular spring) may be replaced with a PTFE oil seal, but not vice versa.

Installing PTFE seal

- Remove oil remains from crankshaft journal with a clean cloth.
- Install guide sleeve T10071/5 onto camshaft journal.

Fig. 110: Installing Guide Sleeve T10071/5 Onto Camshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve.
- Press seal in onto limit stop using press sleeve T10071/3 and bolt M8 x 60 -1-.

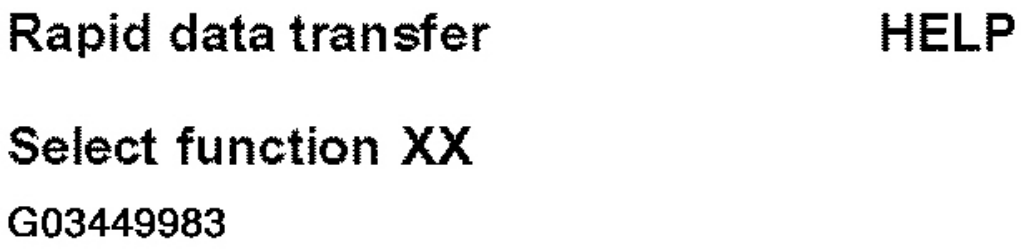

Fig. 111: Pressing Seal In Onto Limit Stop Using Press Sleeve T10071/3 And Bolt M8 X 60
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing seal with annular spring

- Lightly oil sealing lip of oil seal.
- Install guide sleeve 3241/2 onto camshaft journal.

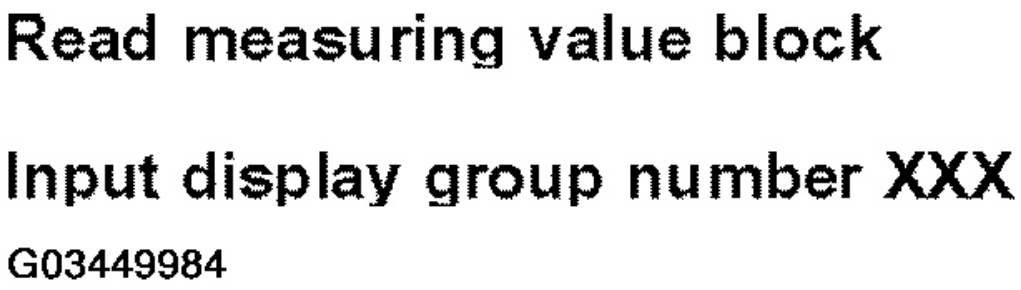

Fig. 112: Installing Guide Sleeve 3241/2 Onto Camshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve.
- Press seal in onto stop with press sleeve 3241/1 and bolt 3241/3.

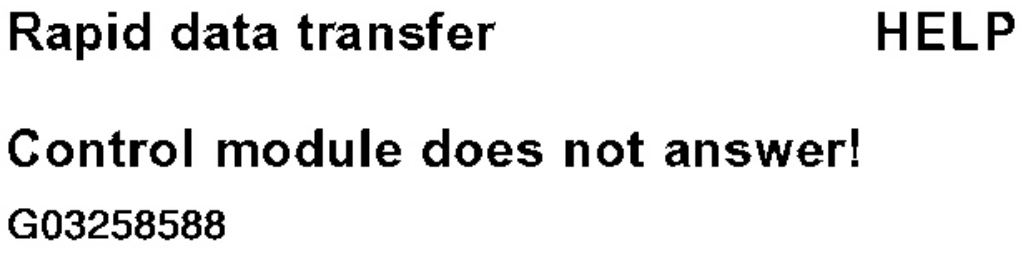

Fig. 113: Pressing Seal In Onto Stop With Press Sleeve 3241/1 And Bolt 3241/3
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Continued for all seals

- Insert Camshaft Position (CMP) sensor hood into notch in inlet camshaft.
- Install washer (taper facing outward) and tighten securing bolt to 25 N.m.
- Install housing for Camshaft Position (CMP) sensor and tighten to 10 N.m.
- Install upper toothed belt guard.
- Reconnect connector on Camshaft Position (CMP) sensor -arrow-.

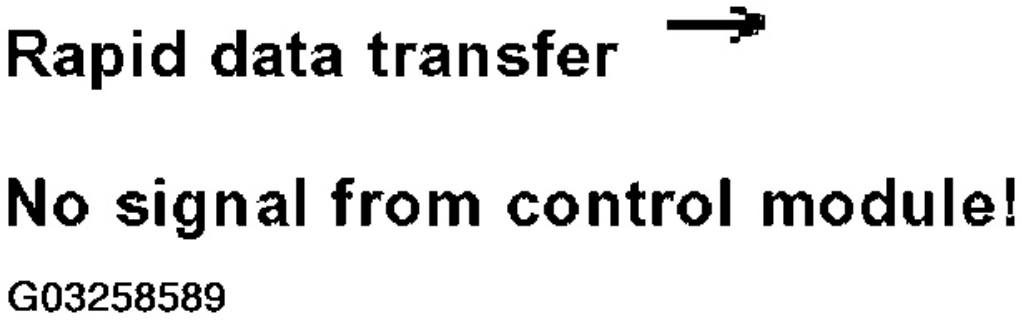

Fig. 114: Reconnecting Connector On Camshaft Position Sensor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Hydraulic lifters, checking

Special tools and equipment

- Feeler gauge
- Wood or plastic wedge

NOTE:

- **Replace faulty lifter complete (cannot be adjusted or repaired).**
- **Irregular valve noises when starting engine are normal.**

Test sequence

- Start engine and run until radiator fan has switched on once.
- Increase engine speed to about 2500 RPM for approx. 2 minutes.

If the hydraulic lifters are still noisy, locate faulty lifters as follows:

- Remove cylinder head cover.
- Rotate crankshaft clockwise, until cam of tappet to be checked is pointing upward.
- Determine play between cam and hydraulic lifter.

If the play is in excess of 0.2 mm, replace hydraulic lifter. If the play is less than 0.1 mm or no play, proceed with check as follows:

- Push hydraulic lifter down lightly with a wooden or plastic wedge. If when hydraulic lifter is pushed down a 0.2 mm thick feeler gauge can be pushed between camshaft and hydraulic lifter, hydraulic lifter is to be replaced.

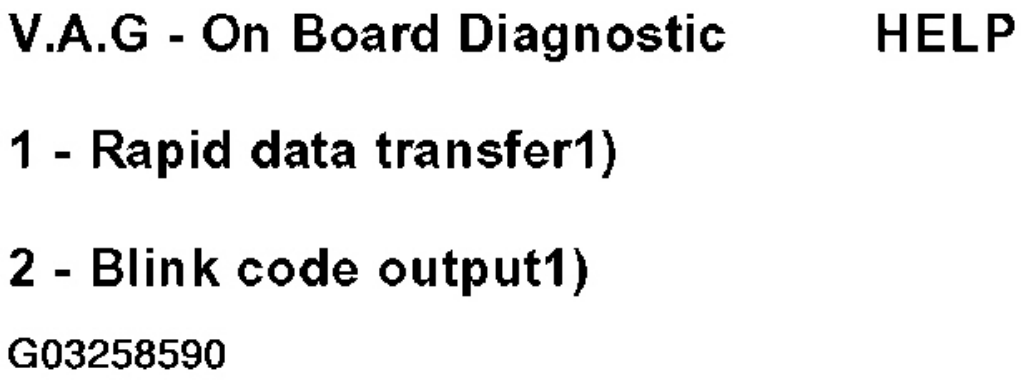

Fig. 115: Pushing Hydraulic Lifter Down Lightly With Wooden Or Plastic Wedge
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: After installing new lifters the engine must not be started for approx. 30 minutes. Hydraulic compensation elements must settle (otherwise valves will strike pistons).

Camshaft, removing and installing

(with cylinder head installed)

Special tools and equipment

- 3036 Counter hold tool
- 3366 Retainer
- VAG 1331 Torque wrench (5 to 50 N.m)
- VAG 1332 Torque wrench (40 to 200 N.m)
- AMV174 004 01 Sealant
- D454 300A2 Sealant

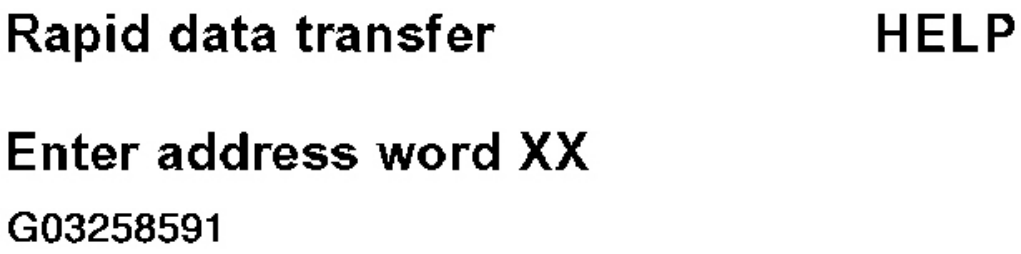

Fig. 116: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove engine cover.
- Remove toothed belt guard (upper part).
- Set camshaft sprocket to TDC No. 1 cylinder by turning crankshaft. Mark on camshaft sprocket must align with mark on cylinder head cover.

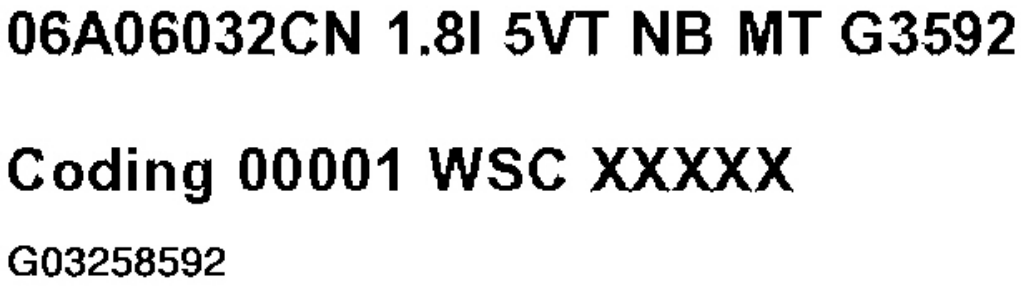

Fig. 117: Aligning Mark On Camshaft Sprocket With Mark On Cylinder Head Cover
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove cylinder head cover.
- Take toothed belt off camshaft toothed belt sprocket. See **REMOVING** .
- Turn crankshaft back slightly.
- Remove camshaft sprocket. When loosening camshaft sprocket bolt counter-hold with 3036.

- Remove woodruff key from camshaft.
- Remove Camshaft Position (CMP) sensor housing.
- Remove washer and hood for Camshaft Position (CMP) sensor.
- Clean drive chain and camshaft chain sprocket in area of arrows on bearing caps and mark installation position with a colored mark.

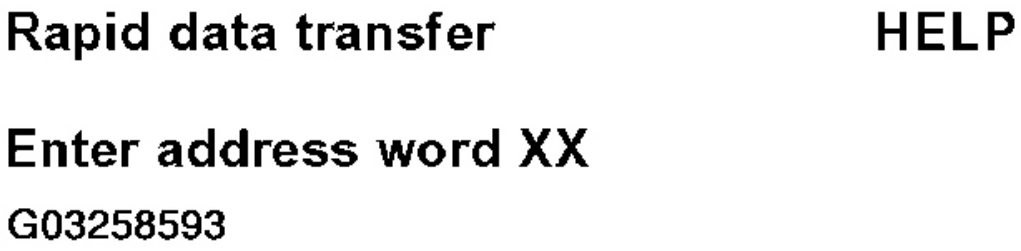

Fig. 118: Cleaning Drive Chain And Camshaft Chain Sprocket In Area Of Arrows On Bearing Caps
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **Do not mark chain with a punched mark, notch or similar.**
- **The distance between both arrows or the colored marks equals 16 rollers on the drive chain.**

- Secure chain tensioner with retainer for chain tensioner 3366.

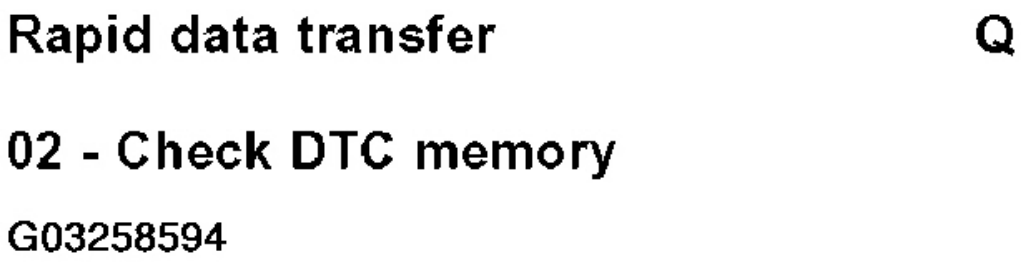

Fig. 119: Securing Chain Tensioner With Retainer For Chain Tensioner 3366
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: **Hydraulic chain tensioner can be damaged if chain tensioner retainer is overtightened.**

- Remove intake and exhaust camshafts 3rd and 5th bearing caps.

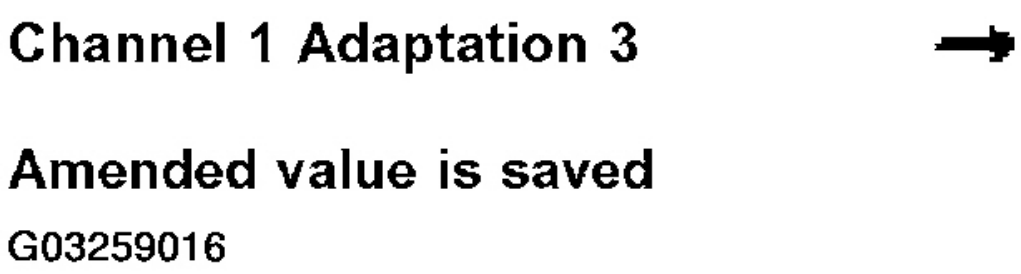

Fig. 120: Identifying Intake And Exhaust Camshaft Bearing Cap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove double bearing cap.
- Remove both bearing caps at chain sprockets on intake and exhaust camshafts.
- Remove chain tensioner securing bolts.
- Remove intake and exhaust camshaft 2nd and 4th bearing caps using alternate and cross-over sequence.
- Remove chain tensioner for intake and exhaust camshafts and retainer for chain tensioner 3366.

Installing

NOTE:
- **When installing the camshafts the cams for No. 1 Cyl. must point upward.**
- **When installing the bearing caps, ensure that the cap markings can be read from the inlet side of the cylinder head.**

- Install drive chain onto both camshafts relevant to colored markings.

NOTE:
- **When using a new timing chain, the distance between notches -A- and -B- at the camshaft equals 16 rollers on the drive chain.**
- **The figure shows where on the sprockets the 1st and 16th rollers must be placed.**
- **Notch -A- is slightly offset toward inside to chain roller 1.**

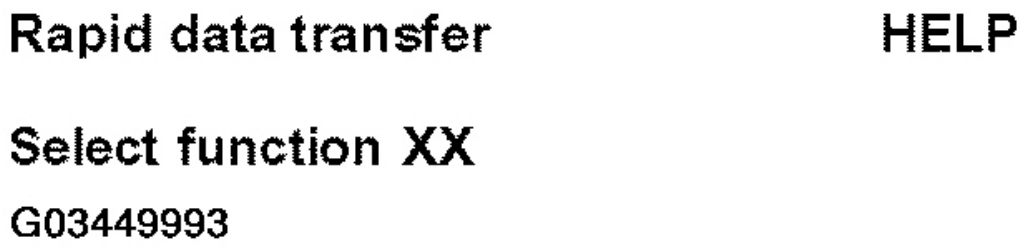

Fig. 121: Identifying Distance Between Notches -A- And -B- At Camshaft
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Replace rubber/metal seal for camshaft adjuster or chain tensioner and lightly coat hatched area with sealant D 454 300 A2.

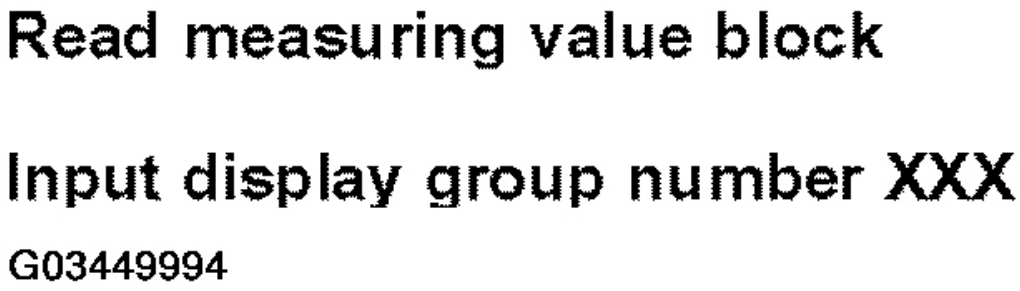

Fig. 122: Identifying Lightly Coated Hatched Area With Sealant D 454 300 A2
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Place chain onto camshaft gears as follows:
- Slide camshaft adjuster or chain tensioner between drive chain.
- Oil running surfaces of both camshafts.
- Place camshafts with drive chain and camshaft adjuster or chain tensioner in cylinder head.
- Tighten camshaft adjuster or chain tensioner to 10 N.m (take note of dowel sleeves).
- Tighten intake and exhaust camshaft 2nd and 4th bearing caps using alternate and cross-over sequence to 10 N.m (take note of dowel sleeves).

Fig. 123: Identifying Intake And Exhaust Camshaft Bearing Caps
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install both bearing caps at chain sprockets for intake and exhaust camshafts. Check camshafts are positioned correctly and tighten bearing cap to 10 N.m (remember dowel sleeves).

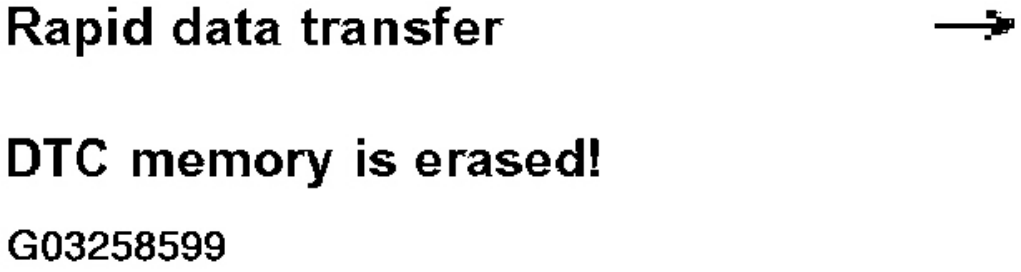

Fig. 124: Installing Both Bearing Caps At Chain Sprockets For Intake And Exhaust Camshafts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove retainer for chain tensioner 3366.
- Coat hatched area of double bearing cap lightly with sealant D 454 300 A2, install and tighten to 10 N.m (remember dowel sleeves).

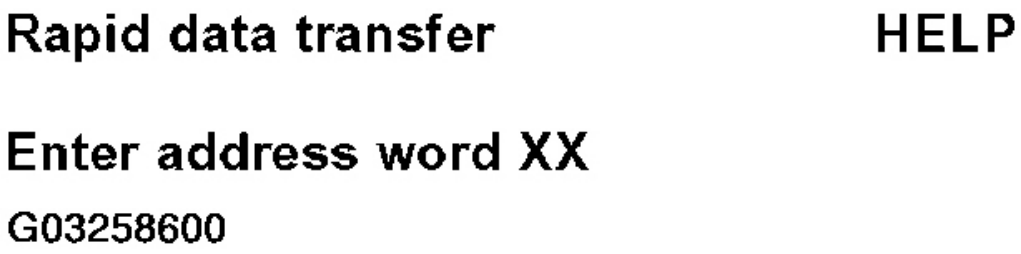

Fig. 125: Identifying Coated Hatched Area Of Double Bearing Cap With Sealant D 454 300 A2
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install remaining bearing caps and tighten to 10 N.m (remember dowel sleeves).
- Observe installation position.
- Install camshaft sprocket. Bevelled edge of camshaft faces outward -arrows- and TDC Cyl. 1 is visible at front

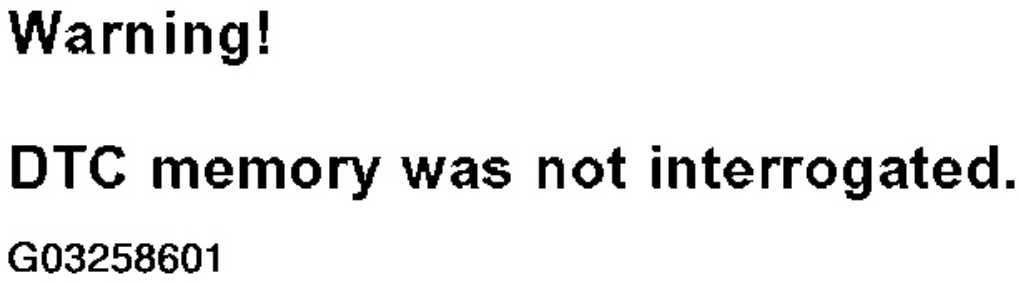

Fig. 126: Installing Camshaft Sprocket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten securing bolt to 65 N.m (use counter-hold tool 3036).
- Recheck position of camshafts relative to one another -arrows-.

Fig. 127: Rechecking Position Of Camshafts Relative To One Another
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing toothed belt and adjusting timing. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .

The rest of the assembly is basically a reverse of the disassembling sequence.

NOTE: After installing new lifters the engine must not be started for approx. 30 minutes. Hydraulic compensation elements must settle (otherwise valves will strike pistons).

Camshaft adjustment, checking

Only vehicles with engine codes: AWP, AWV

The adjustment of the camshaft occurs dependent upon load and engine RPM. The electrical valve for camshaft adjustment directs oil pressure to the camshaft adjuster (mechanical adjustment device), which then moves the camshaft.

Special tools and equipment

- VAG 1551 Scan Tool or VAG 1552 vehicle system tester with VAG 1551/3 cable
- Hand multimeter VAG 1526 or multimeter VAG 1715
- Adapter set VAG 1594
- VAG 1788/10 Engine speed adjuster

Checking activation

- Check activation of solenoid valve for camshaft adjustment via Output Diagnostic Test Mode.

  For engine code APH, see **OUTPUT DIAGNOSTIC TEST MODE (DTM)** . For engine codes AWP

and AWV, see **OUTPUT DIAGNOSTIC TEST MODE (DTM)** .

If activation is OK:

Checking solenoid valve

- Measure resistance between solenoid valve terminals.

  Specification: 10 to 18 ohms (room temperature)

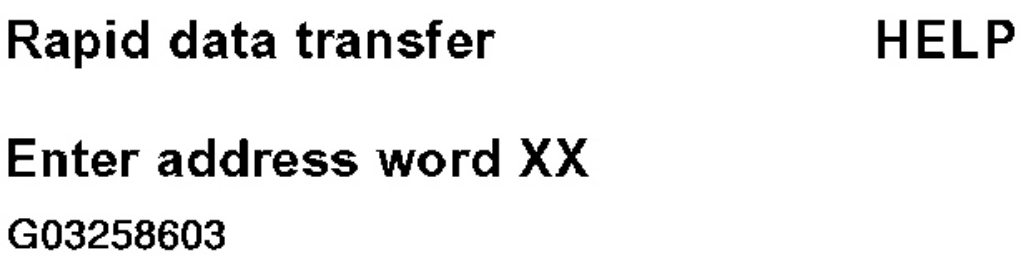

Fig. 128: Measuring Resistance Between Solenoid Valve Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If valve is not faulty:

- Check function of camshaft adjuster

Checking function of camshaft adjuster

Test conditions

- Coolant temperature must be at least 85 °C, see display group 04, display zone 3.

Test sequence

- Connect VAG 1551 Scan Tool (or VAG 1552). Start engine and select Engine Control Module with "Address word" 01. Connecting scan tool and selecting Engine Control Module: See **CONNECT DIAGNOSTIC TESTER** .

Indicated on display:

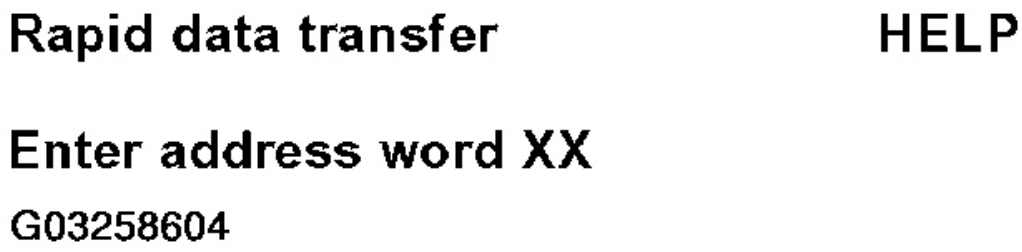

Fig. 129: V.A.G 1551 Scan Tool Display - Checking Function Of Camshaft Adjuster (1 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0- and -4- for function "Introduction of basic setting" and confirm entry with -Q- button.

Indicated on display:

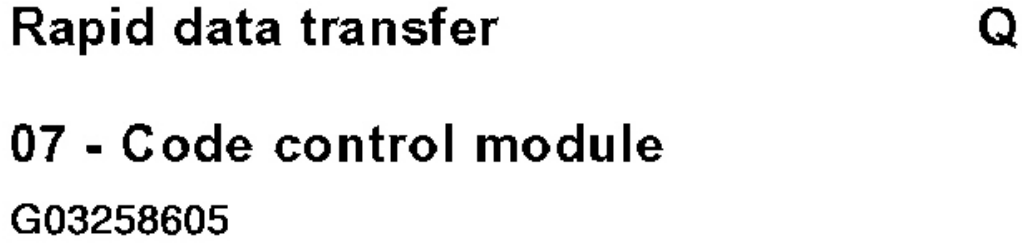

Fig. 130: V.A.G 1551 Scan Tool Display - Checking Function Of Camshaft Adjuster (2 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0-, -9- and -4- for "Display group number 94" and confirm entry with -Q- button.

Indicated on display: (1 to 4 = Display zones)

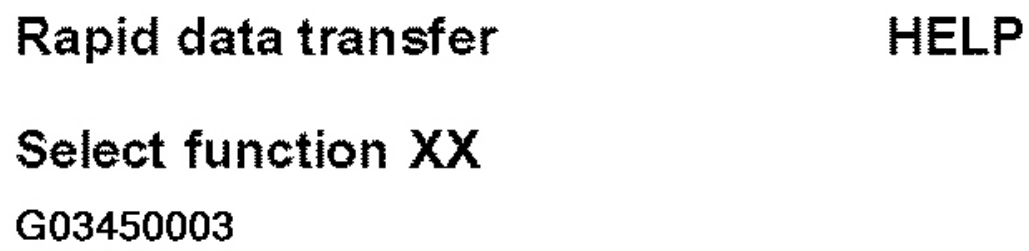

Fig. 131: V.A.G 1551 Scan Tool Display - Checking Function Of Camshaft Adjuster (3 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Set engine speed to 1800 to 2200 RPM using speed regulator VAG 1788/10:
- Maintain engine speed at 1800 to 2200 RPM until display in display zone 3 jumps from

  "Test OFF" to "Test ON".

- Continue to maintain speed at 1800 to 2200 RPM until specification

  "Syst. OK" appears in display zone 3.

If the display does not indicate as described:

- Remove engine speed adjuster VAG 1788/10 from accelerator pedal.
- Press. See button.

Indicated on display

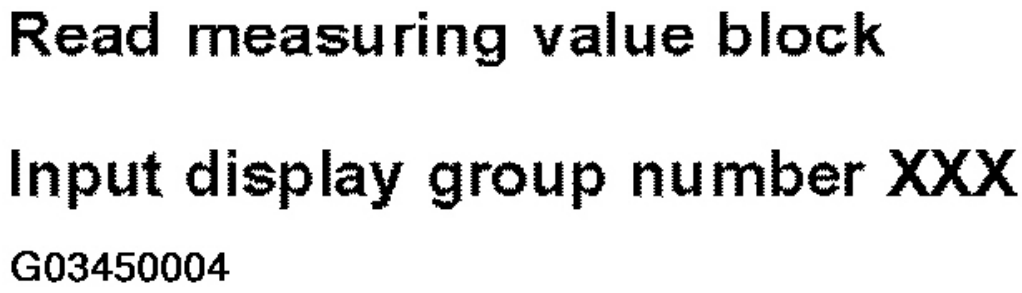

Fig. 132: V.A.G 1551 Scan Tool Display - Checking Function Of Camshaft Adjuster (4 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0- and -6- for function "End output" and confirm entry with -Q- button.
- Switch ignition off.

If "Syst. Nok" appears in display zone 3:

- Read DTC memory.

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

If the DTC 17927 appears, it may be because:

The camshaft adjuster solenoid valve correctly switches oil pressure to the mechanical camshaft adjuster but it cannot reach its end position (e.g. tight/partially seized).

- Replace camshaft adjuster.
- Check DTC memory:

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

- Read readiness code:

  See **READINESS CODE** .

If the DTC memory has been erased or the Engine Control Module separated from permanent (battery) positive, the readiness code must be generated again.

See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

- Repeat functional check.

If the specification is not attained:

- Check wiring for open/short circuit between Engine Control Module to camshaft adjuster solenoid valve using wiring diagram:

  See appropriate SYSTEM WIRING DIAGRAM article.

If no wiring problem is detected:

- Replace Engine Control Module:

  See **REPLACING ENGINE CONTROL MODULE (ECM)** .

Valve guides, checking

Special tools and equipment

- VW 387 Universal dial indicator bracket
- Dial indicator

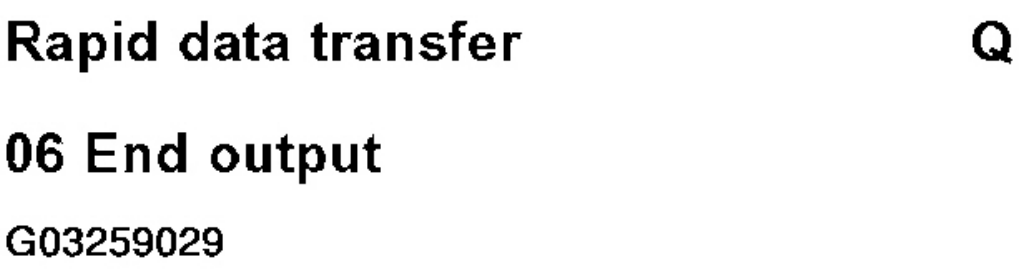

Fig. 133: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Test sequence

- Insert new valve into guide until end of valve stem is flush with end of guide. Due to slight difference in stem dimensions, ensure that only an intake valve is used in intake guide and an exhaust valve in exhaust guide.

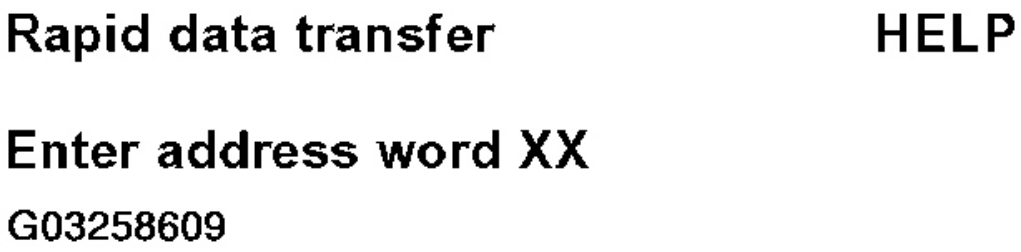

Fig. 134: Determining Valve Rock
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Determine valve rock.

  Wear limit: 0.8 mm

If rock tolerance is exceeded:

- Replace cylinder head.

Valve guides, replacing

Special tools and equipment

- Press tool VW 411
- Drift 3360
- Support 3361
- Hand reamer 3363 and cutting fluid

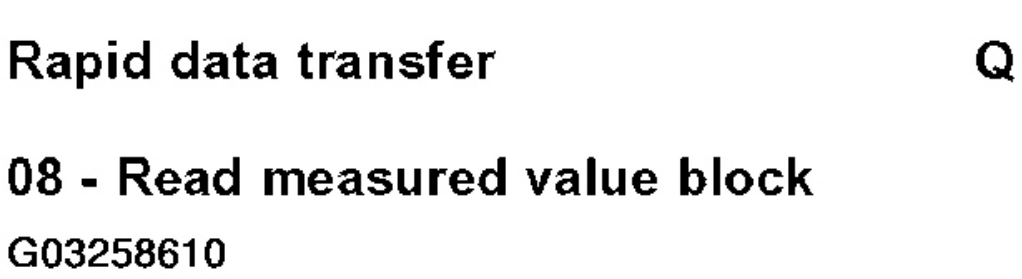

Fig. 135: Identifying Press Tool VW 411
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Check whether valve seat insert rings and if necessary cylinder head sealing surface can be reworked. If not, then valve guide should not be replaced.

First set the support as follows:

- Install mount pins for cylinder head bolt holes -A- into threaded hole positions 2 and 3.

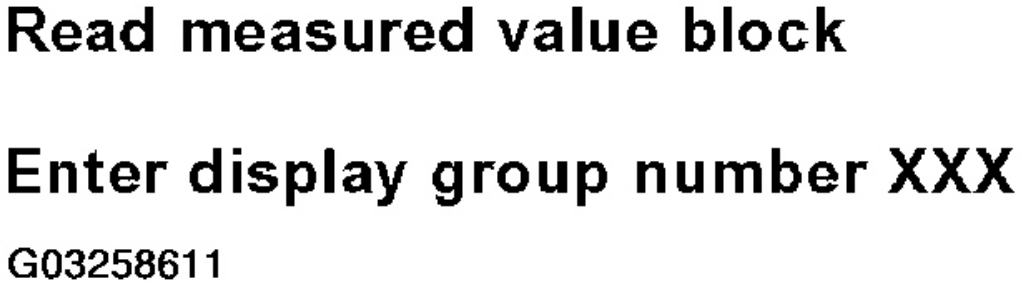

Fig. 136: Installing Mount Pins For Cylinder Head Bolt Holes -A- Into Threaded Hole Positions 2 And 3
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install pin -B- into relevant hole for valve angle.
  - Outer intake valves: 21.5°

- Center intake valve: 15°
- Exhaust valve: 20°

- Press worn valve guides out with drift 3360 from camshaft side.

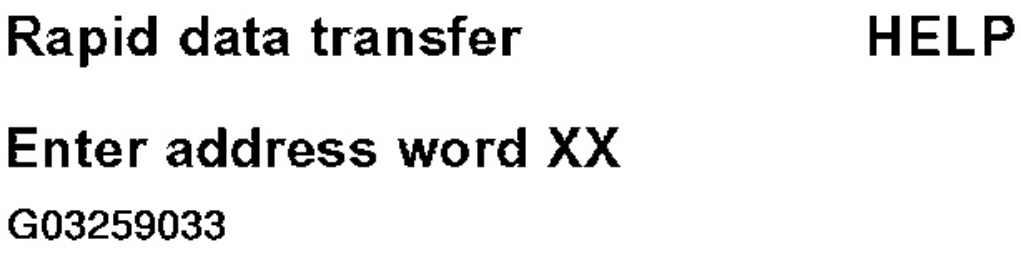

Fig. 137: Pressing Worn Valve Guides Out With Drift 3360 From Camshaft Side
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE: When the shoulder on guide makes contact, the pressure must not exceed 10 kN (approx. 1.0 t) otherwise shoulder may break off.

- Coat new valve guides with oil and press with drift 3360 into cold cylinder head from camshaft side until shoulder makes contact.
- Ream guides out with hand reamer 3363 using plenty of cutting fluid.
- Rework valve seats. See **VALVE SEATS, REFACING** .

Valve stem seals, replacing

(with cylinder head installed)

Special tools and equipment

- VAG1331 Torque wrench (5-50 N.m)
- VAG1332 Torque wrench (40-200 N.m)
- 3122B Spark plug removal tool
- 3364 Puller
- VW 653/3 Pressure hose
- 3362 Valve spring compressor and press piece 3362/1

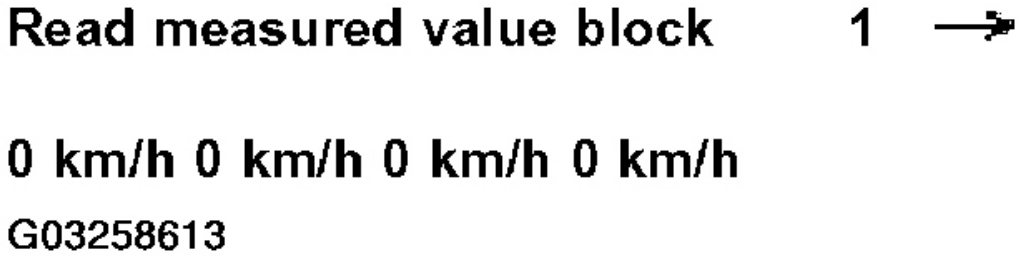

Fig. 138: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- 3365 Fitting tool

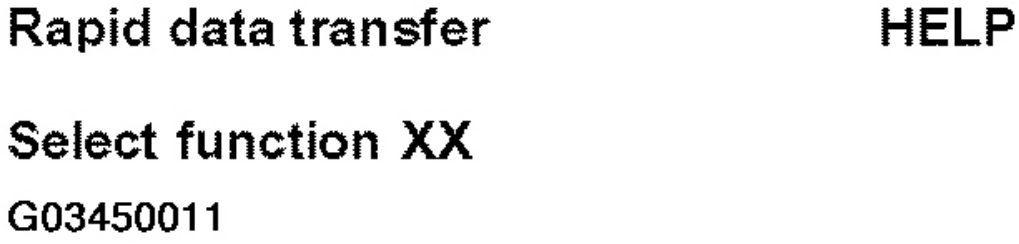

Fig. 139: Identifying 3365 Fitting Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove camshafts. See **CAMSHAFT, REMOVING AND INSTALLING** .
- Remove hydraulic lifters and place them with contact surface downward. When doing this ensure that lifters are not interchanged.
- Remove spark plugs with spark plug removal tool3122B.
- Set piston of appropriate cylinder to BDC (bottom dead center).
- Screw pressure hose VW 653/3 into spark plug thread.
- Mount fitting tool 3362 on cylinder head with fitting tool securing bolts.

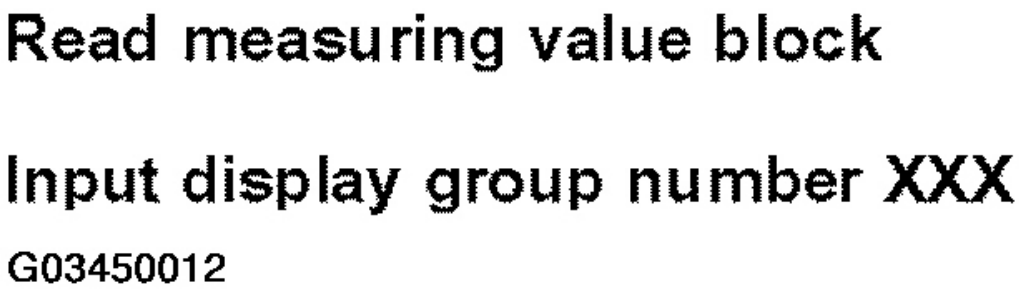

Fig. 140: Mounting Fitting Tool 3362 On Cylinder Head With Fitting Tool Securing Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Position fitting tool for compressing valve springs to one of following positions:

  Outer intake valves: lower position

  Center intake valve: upper position

  Exhaust valve: lower position

- Connect pressure hose to compressed air system supplying at least 6 bar and remove valve springs.
- Pull off valve stem seals with 3364.

Fig. 141: Pulling Off Valve Stem Seals With 3364
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

- Place plastic sleeve -A- supplied on appropriate valve stem. This will prevent new valve stem seal being damaged.

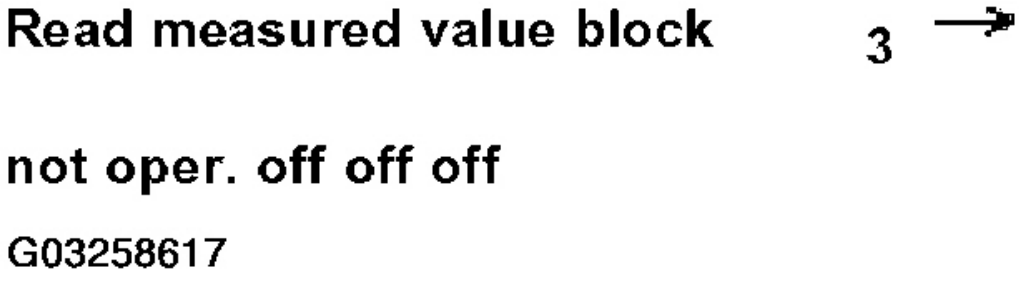

Fig. 142: Placing Plastic Sleeve -A- Supplied On Appropriate Valve Stem
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Place new valve stem seal in fitting tool 3365.
- Oil sealing lip of valve stem seal -B- insert in installation tool 3365 and press carefully onto valve guide.

The rest of the assembly is basically a reverse of the disassembling sequence.

ENGINE - LUBRICATION

LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING

NOTE:

- **If large quantities of metal particles or other deposits (caused, for example, by partial seizure of the crankshaft or connecting rod bearings) are found in the engine oil when performing repairs, clean the oil passages thoroughly and replace the oil cooler in order to prevent further damage from occurring later.**
- **The oil level must not be above the max. mark, or there is danger of damage to the catalyst! Marking. See Markings On Oil Dipstick .**
  - **Thoroughly clean oil passages**
  - **Replace oil spray jets, oil cooler, and oil filter**

Checking oil pressure and oil pressure switch. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING** .

Oil system capacity:

- Without oil filter: 4.0 liters
- With oil filter: 4.5 liters (4.8 qt.)

Oil Capacities up to MY 2000

Checking oil pressure. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING** .

Engine oil specifications:

The following terms must appear on the oil container singly or in combination with other designations:

- VW 502 00 or VW500 00 or VW501 01
- ACEA A2 or ACEA A3
- API-SJ or API-SL

- Engine oils are graded according to their viscosity. The proper grade to be used in your engine depends on existing climatic or seasonal conditions.
- The engine oil which was first put into your engine has a viscosity grade of SAE 5W-40. You can use this oil over all temperature ranges for normal driving. If engine oil viscosity grade SAE 5W-40 is not available, you can also use SAE 5W-30.

Part I

Part II, disassembly oil filter bracket. See **PART II** .

NOTE: The following list refers to items in Fig. 143 .

1. **15 N.m**
2. **Sealing flange**
   - Must be located on dowel sleeves
   - Clean sealing surface before installing
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
   - Replacing crankshaft oil seal (pulley end). See **CRANKSHAFT OIL SEAL (BELT PULLEY END), REPLACING** .
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
3. **Chain tensioner with tensioning rail, 15 N.m**
   - Check for wear
   - When installing, pretension spring and install
4. **Chain sprocket**
   - For oil pump drive
   - Check for wear
5. **Cylinder block**
   - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING** .

- Disassembling and assembling pistons and connecting rods. See **PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING** .

6. **Dipstick**
   - Oil level must not be above max. mark!
   - Markings. See **Markings On Oil Dipstick** .
7. **Guide**
   - For dipstick
   - Pull off to extract oil
8. **Guide tube**
9. **Oil spray jet**
   - For piston cooling
10. **Pressure relieve valve, 27 N.m**
    - Opening pressure: 1.3 to 1.6 bar
11. **15 N.m**
12. **Suction pipe**
    - Clean strainer if soiled
13. **O-ring**
    - Replace
14. **Baffle plate**
15. **15 N.m**
    - Loosen and tighten with T-bar and socket, 10 mm 3185
    - Remove with hexagon key extension, 5 mm 3249
16. **Oil pan**
    - Clean sealing surface before installing
    - Install with silicone sealant D 176 404 A2. See **OIL PAN, REMOVING AND INSTALLING** .
    - Removing and installing. See **OIL PAN, REMOVING AND INSTALLING** .
17. **Oil drain plug, 30 N.m**
    - Replace if leaking. See Parts Catalog for correct application. In some cases, seal and drain plug are combined; do not interchange with separate seal and drain plug.
    - If sealing ring is leaking nip open and replace.
18. **Seal**
    - Replace
19. **Oil return pipe**
    - From turbocharger
20. **10 N.m**
21. **Oil pump**
    - With positive pressure relief valve 12 bar
    - Before installing, check that both dowel sleeves for centering oil pump/cylinder head are installed

- Replace if running surfaces and gears are scored

22. **Chain sprocket**
    - For oil pump
    - Check for wear
23. **25 N.m**
24. **Roller chain**
    - Mark direction of rotation before removing
    - Check for wear
25. **Dowel sleeves**
    - Check for tight fit

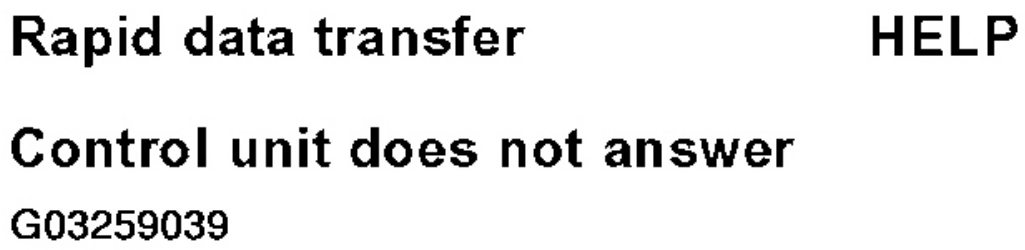

Fig. 143: Exploded View Of Lubrication System Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Markings On Oil Dipstick

1. max. mark
2. min. mark
    a. Area above hatched field up to max. mark: Do not top off with engine oil!
    b. Oil level within hatched field: can be topped off with engine oil
    c. Area from min. mark up to hatched field: fill with max. 0.5L. of engine oil!

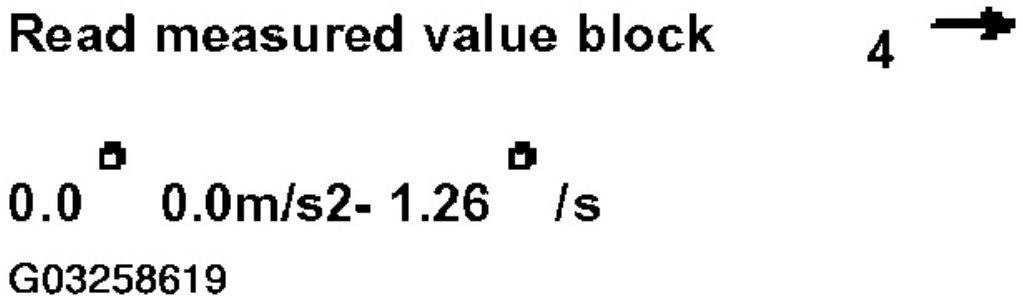

Fig. 144: Identifying Markings On Oil Dipstick
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part II

NOTE: The following list refers to items in Fig. 145 .

1. **Sealing plug, 40 N.m**
2. **Seal**
   - If sealing ring is leaking nip open and replace.
3. **Spring**
   - For pressure relief valve, approx. 4 bar
4. **Piston**
   - For pressure relief valve, approx. 4 bar
5. **Gasket**
   - Replace
6. **Non-return valve, 8 N.m**
7. **O-ring**
   - Replace
   - Fit onto shoulder of connecting pipe 8 -
8. **Connecting pipe**
   - For cylinder block breather
9. **Retaining clip**
   - Check for tight fit
10. **Sealing plug, 15 N.m**
11. **Seal**
    - If sealing ring is leaking nip open and replace

12. **20 N.m**
13. **Oil supply pipe**
    - To turbocharger
14. **Banjo bolt, 30 N.m**
15. **Gasket**
    - Replace
16. **1.4 bar oil pressure switch -F1-, 25 N.m**
    - Black
    - Checking. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING** .
17. **Seal**
    - If sealing ring is leaking nip open and replace
18. **15 N.m + 1/4 turn (90°) further**
    - Replace
19. **Gasket**
    - Replace
    - Install into groove on oil cooler
20. **Oil filter**
    - Loosen with strap wrench
    - Tighten by hand
    - Observe installation instructions on oil filter
21. **25 N.m**
22. **Oil cooler**
    - Ensure clearance to adjacent components
    - See note. See **LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING** .
    - Coat contact area to flange, outside seal, with AMV 188 100 02
23. **Oil filter bracket**
    - With pressure relief valve approx. 4 bar

Fig. 145: Identifying Filter Bracket Assembly Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Oil pan, removing and installing

Special tools and equipment

- 3185 Extension socket wrench

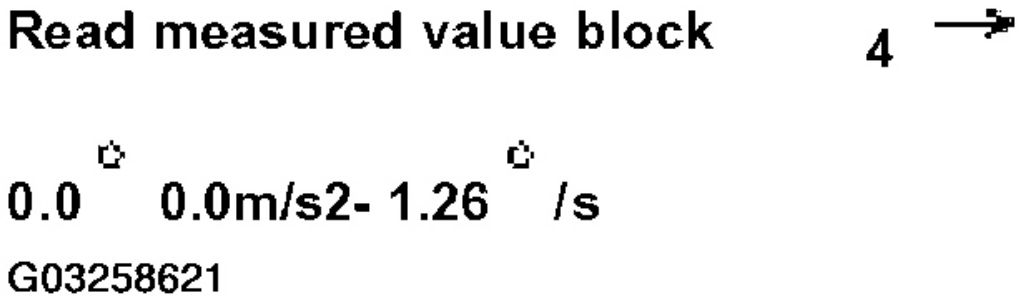

Fig. 146: Identifying 3185 Extension Socket Wrench
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- 3249 Socket

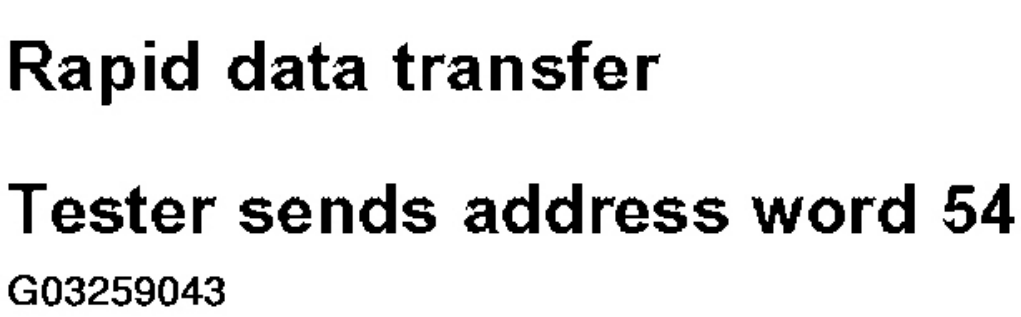

Fig. 147: Identifying 3249 Socket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG 1331 Torque wrench (5 to 50 N.m)
- Silicone sealant D 176 404 A2
- Hand drill with plastic brush
- Protective glasses
- Flat scraper

Removing

- Removing center and right insulation tray:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING** .

- Drain engine oil.

NOTE: Observe disposal regulations!

- Detach turbocharger oil return pipe from oil pan.
- Loosen oil pan bolts using extension socket wrench 3185. Unscrew with socket 3249.
- Remove oil pan; it may be necessary to release oil pan by tapping lightly with a rubber head hammer.
- Remove sealant residue on cylinder block with a flat scraper.
- Remove sealant residue on oil pan with a rotating brush, e.g. a hand drill with a plastic brush (wear protective glasses).

Fig. 148: Removing Sealant Residue On Oil Pan With Rotating Brush
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Clean sealing surface; it must be free of oil and grease.

Installing

NOTE:

- **Note the use by date of the sealant.**
- **Oil pan must be installed within 5 minutes of applying silicone sealing compound.**

- Cut off tube nozzle at forward marking (nozzle approx. 3 mm diameter).

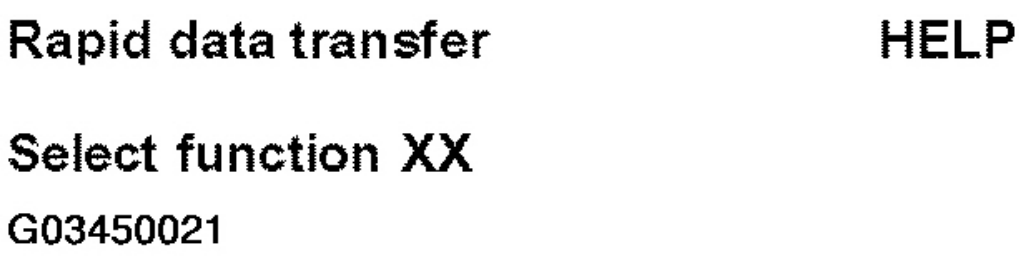

Fig. 149: Cutting Off Tube Nozzle At Forward Marking
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Apply silicone sealing compound, as shown, to clean oil pan sealing surface.

  Sealing compound bead must be:

  - 2-3 mm thick
  - and run on inside of bolt holes -arrows-

NOTE: **The sealing compound bead must not be thicker, otherwise excess sealing compound will enter the oil pan and may block the oil suction pipe strainer.**

- Apply silicone sealing bead as shown to clean sealing surface of oil pan (illustration shows position of sealant bead on cylinder block).

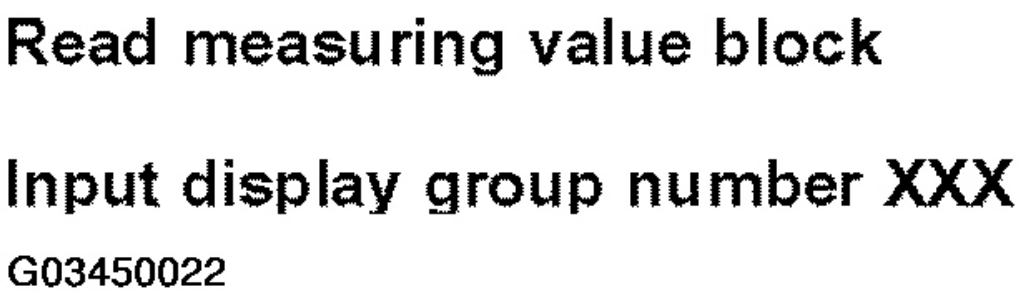

Fig. 150: Applying Silicone Sealing Bead To Clean Sealing Surface Of Oil Pan
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install oil pan immediately and tighten bolts as follows:

1. Tighten all bolts oil pan/cylinder block very lightly and diagonally.
2. Lightly tighten three bolts oil pan/transmission.
3. Lightly tighten all bolts oil pan/cylinder block diagonally.
4. Tighten three bolts oil pan/transmission to 45 N.m.
5. Tighten all bolts oil pan/cylinder block diagonally to 15 N.m.
6. Tighten oil pan/oil return pipe to 10 N.m.

NOTE:

- **When installing the oil pan on an engine which is out of vehicle, ensure that the oil pan is flush with cylinder block on flywheel end.**
- **The sealant must be allowed to dry for approx. 30 minutes after installing the oil pan before the engine can be filled with engine oil.**

The rest of the assembly is basically a reverse of the disassembly sequence.

Oil pressure and oil pressure switch, checking

Special tools and equipment

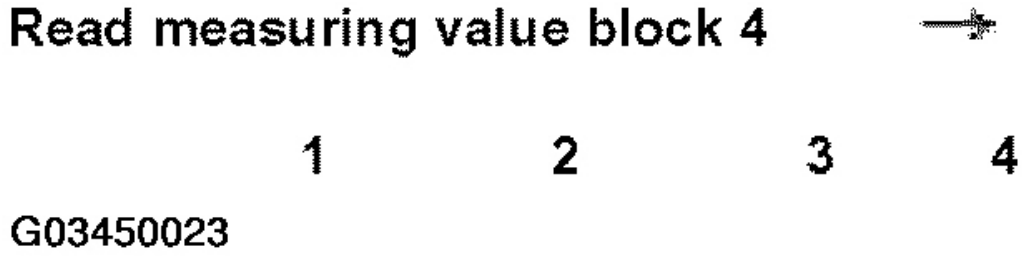

Fig. 151: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG 1342 Oil pressure tester
- VAG 1527 BLED test light
- VAG 1594 A Adapter set

Function of the dynamic oil pressure warning indicator

- When not under pressure, the oil pressure switch is open and will close when the operating pressure is attained.
- The oil pressure warning will be activated approx. 10 seconds after switching the ignition on.
- Switch-in delay of oil pressure warning: approx. 3 seconds.
- Switch-off delay of oil pressure warning: approx. 5 seconds.

NOTE: Functional check and servicing the optical and acoustic oil pressure warning:

See appropriate WIRING DIAGRAM article.

Checking warning lamp

After switching on the ignition without engine started, the oil pressure warning lamp in instrument cluster must light for approx. 3 seconds and then go out. The test will be terminated if the engine is running.

Criteria for warning

Switching on the optical oil pressure warning (the oil pressure warning lamp flashes) and the buzzer sounding three times for the acoustical warning will occur under one of the following conditions:

- "Ignition on," engine stationary, oil pressure switch closed

- Engine speed above 1500 RPM, oil pressure switch open

NOTE:

- **If the oil pressure switch is closed, the warning lamp will remain switched on if the engine speed is above 5000 RPM. The warning lamp will be switched off again if the engine speed is below 5000 RPM.**
- **If the oil pressure switch is open for 0.3-3.0 seconds when the engine speed is above 1500 RPM, it will be stored in the combi-processor in the instrument cluster. If this condition occurs three times when the engine is running, the oil pressure warning will be activated and will not be cancelled even below 1500 RPM. The oil pressure warning will be cancelled when the oil pressure switch is closed for longer than 5 seconds at an engine speed above 1500 RPM, or when the ignition is switched off.**

Test conditions

- Engine oil level OK. See **PART II**
- Oil Pressure Warning Lamp -K3- must light up for approx. 3 seconds when ignition is switched on
- Engine oil temperature at least 80° C (radiator fan must have run once)

Test sequence

- Remove Oil Pressure Switch -F1- and screw into tester.

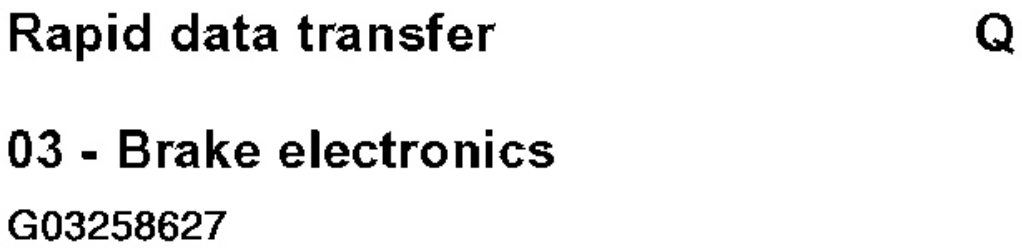

Fig. 152: Removing Oil Pressure Switch -F1- And Screwing Into Tester
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Screw tester into oil filter bracket in place of oil pressure switch.
- Connect brown wire of tester to Ground (-).
- Connect LED test light VAG 1527 B using aux. cables from VAG 1594 A to battery positive (+) and oil

pressure switch.

LED must not light up.

- If LED lights up, replace 1.4 bar Oil Pressure Switch -F1-.

When the LED does not light up:

- Start engine and run at idling speed:

  At 1.2-1.6 bar LED must light up, otherwise replace oil pressure switch.

- Check oil pressure at different RPMs:
  - Idle: at least 2.0 bar
  - 2000 RPM: 2.7 to 4.5 bar
  - Above 2000 RPM: maximum 7.0 bar

If the specifications are not obtained:

- Repair mechanical damage (e.g. bearing damage).
- Replace oil filter bracket with pressure relief valve (see **OIL PAN, REMOVING AND INSTALLING** , item 23) or replace oil pump (see **PART II** , item 21).

At higher engine speeds the oil pressure must not exceed 7.0 bar.

If the specification is exceeded:

- Check oil galleys.
- If necessary, replace oil filter bracket with pressure relief valve. See **OIL PAN, REMOVING AND INSTALLING** , item 23.